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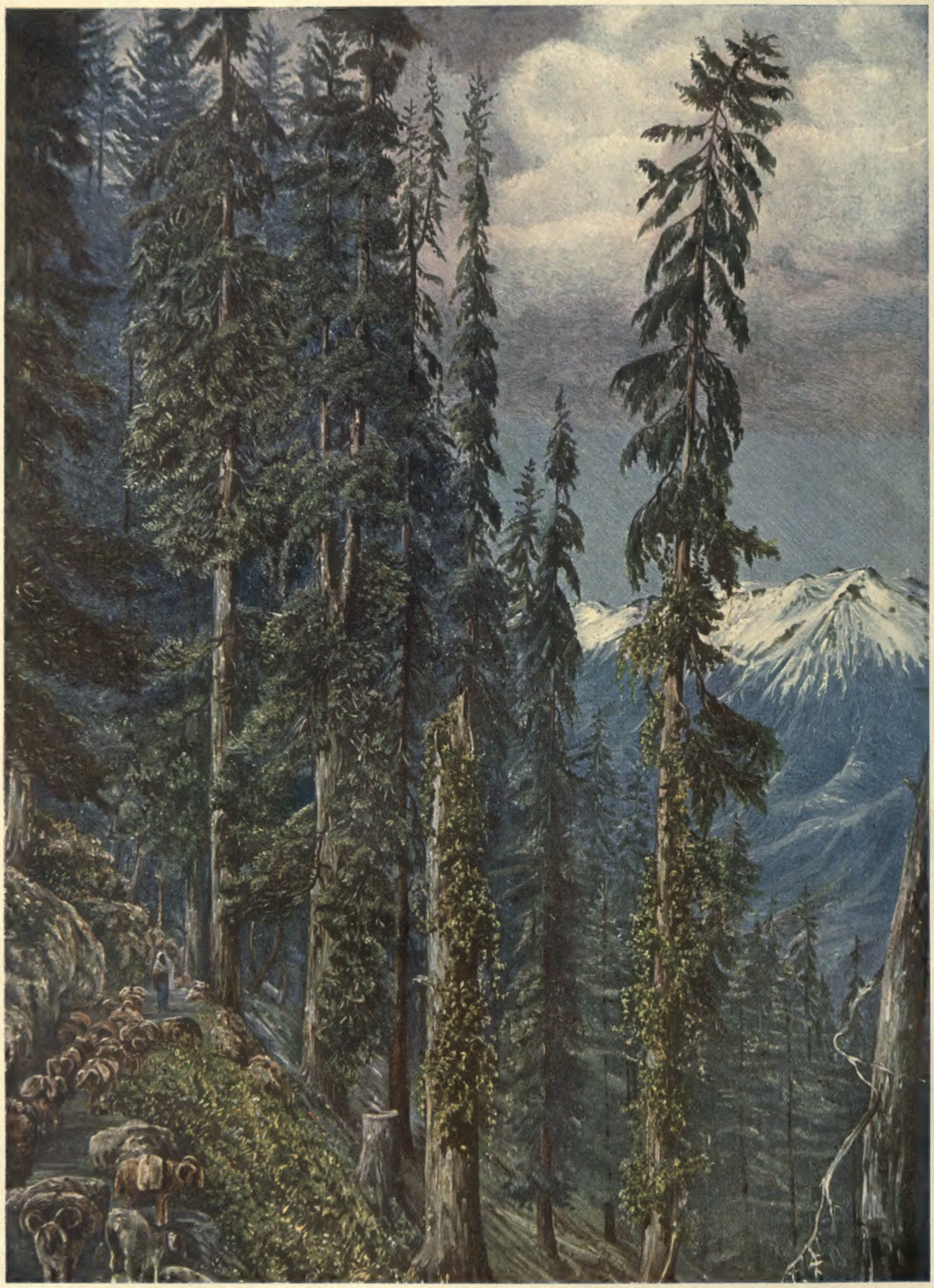

HIMALAYAN SPRUCE ON THE ROAD NEAR NAGKUNDA

*From a Drawing by the late Miss North*

# The Trees
of
# Great Britain
# & Ireland

by

Henry John Elwes, F.R.S

and

Augustine Henry, M.A

VOLUME V

Edinburgh : Privately Printed

MCMX

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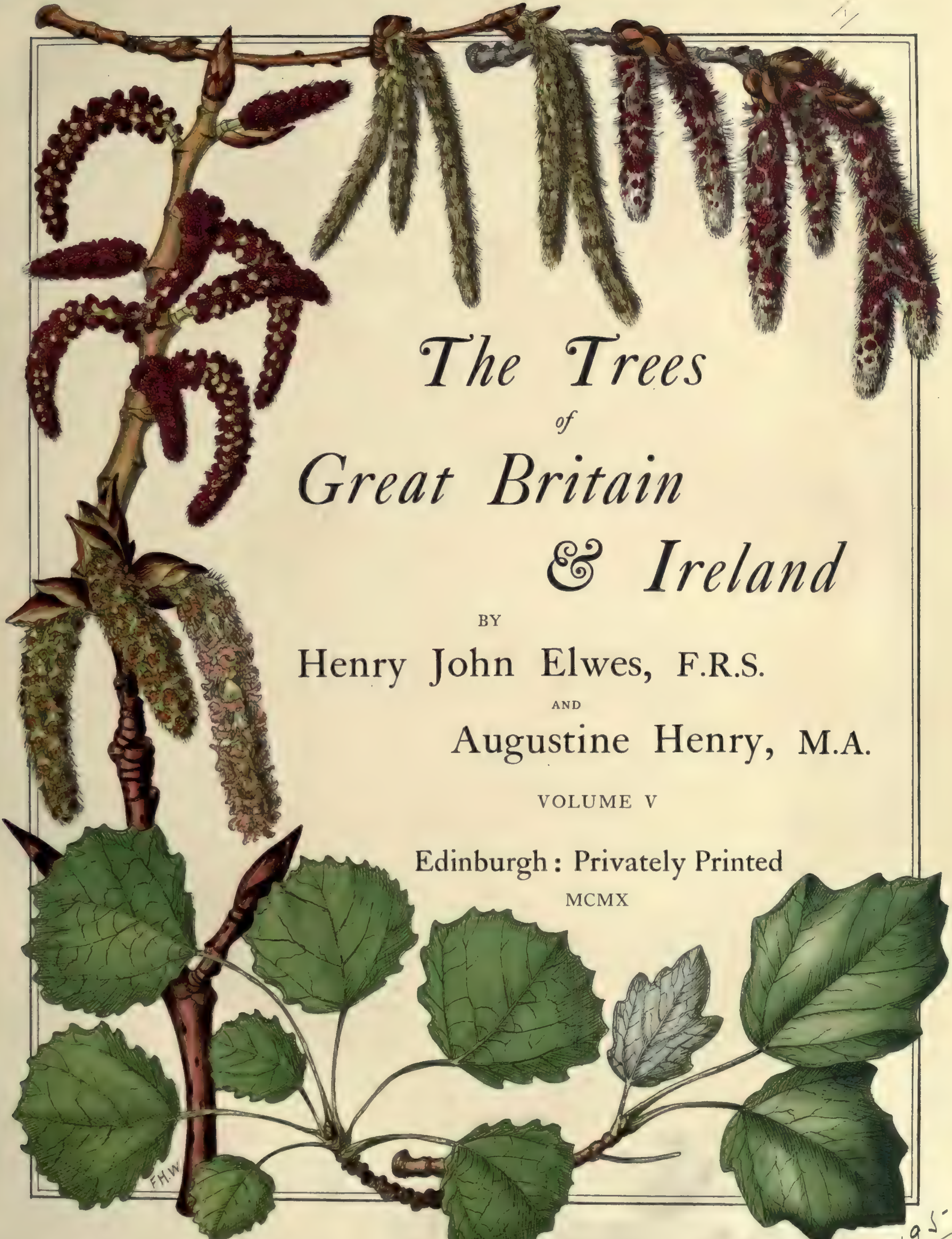

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# PINUS

*Pinus*, Linnæus, *Gen. Pl.* 293 (*ex parte*) (1737); Duhamel, *Traité des Arbres*, ii. 121 (1755); Bentham et Hooker, *Gen. Pl.* iii. 438 (1880); Engelmann, in *Trans. Acad. St. Louis*, iv. 161 (1886); Masters, in *Journ. Linn. Soc.* (*Bot.*), xxvii. 236, 248, 258, 269, 309 (1891), xxx. 37 (1893), and xxxv. 560 (1904); Mayr, *Wald. Nordam.* 425 (1890), and *Fremdländ. Wald- u. Parkbäume*, 340 (1906); Shaw, in *Bot. Gaz.* xliii. 205 (1907).

EVERGREEN trees or shrubs, belonging to the division Abietineæ of the order Coniferæ. Bark usually thick, rough, and deeply fissured; but in some species thin and scaly, and in a few others peeling off in thin flakes like a plane tree. Branches arising from the stem in apparent whorls. Shoots of two kinds: short shoots, which are minute spurs of limited growth, bearing the adult leaves in clusters and deciduous with them; and long shoots, the ordinary branchlets, which continue growth.

In the majority[1] of pines, the long shoot produced in spring is a single internode, consisting of (*a*) a leafless base, which bears the staminate flowers, when these are developed; and (*b*) a longer upper portion bearing foliage, and ending in (*c*) a terminal bud, subtended by a whorl of smaller buds, one or more of which may be replaced by pistillate flowers (young cones). The buds and young cones being close to the apex of the shoot, are said to be subterminal. In the second year the mature cones and the branchlets, which have developed from the single whorl of buds of the first year, are situated beneath the base of the new shoot of the year, which has sprung from the terminal bud of the preceding season.

In another group[2] of pines, the long shoot produced in spring consists of two (rarely three or more) internodes, each with a leafless base, a leaf-bearing portion, and a whorl of buds (with or without young cones). The buds and young cones are in two or more whorls, and are both subterminal and lateral in position. Similarly, in the second year, the branchlets and mature cones are in two or more whorls.

In young or vigorous trees of any species of either group the subterminal whorl of buds and young cones, already formed in spring, is occasionally placed in a lateral position by the development above it of a summer shoot, which is distinguished from the normal spring shoot with long leaves and brown withered scale-leaves, by bearing short leaves with green scale-leaves. In this exceptional case, which is, however, common in certain species, the buds and cones are said to be pseudo-lateral.

---

[1] Termed uninodal pines by Shaw.

[2] Multinodal pines of Shaw, who points out that when the trees are old or diminishing in vigour, they often produce shoots with only one whorl of buds, but recognisable as having two internodes by the presence of two leafless bases; or they may, when very feeble, only develop one internode to each shoot.

Buds, varying in the different species in shape and in the characters of their spirally imbricated scales, which are united together by their fringed margins or matted hairs, or are embedded in resin, their tips being erect, spreading, or reflexed. The buds are compound; their outer scales empty and persistent at the base of the shoot, when the bud unfolds; their inner scales enclosing minute buds, which develop into the short shoots and adult foliage (and when flower-bearing, into the staminate flowers as well). These inner scales persist on the developed branchlets as scale-leaves.

Leaves of three kinds: (*a*) Primordial leaves, borne on seedling plants, solitary, spirally arranged, spreading, linear-lanceolate, keeled on both surfaces, serrulate. (*b*) Scale-leaves, containing in their axils the short shoots and adult leaves, triangular-lanceolate, entire or fringed in margin, usually[1] quickly deciduous in part, their basal portion only persisting. (*c*) Adult leaves, needle-like, persistent two to twenty years, in clusters of one to five (rarely six or seven), at the apex of the short shoot, serrulate or entire in margin; section[2] plano-convex in two-leaved species, triangular in three- to five-leaved species; fibro-vascular bundle branched or simple; resin-canals, two to twelve, marginal or median. The sheath at the base of each cluster, formed by the scales of the minute buds, is either quickly and entirely deciduous or persistent; in the latter case usually becoming, with age, shortened, blackened, and lacerated, but in certain species dividing into segments, which become reflexed and surround the base of the leaf-bundle as a rosette.

Flowers monœcious. Staminate flowers,[3] clustered in a head or spike at the base of the current year's shoot, ovoid or cylindrical, surrounded at the base by an involucre of scale-like bracts, composed of numerous imbricated sessile two-celled anthers; connective crest-like, nearly orbicular; pollen-grains with two lateral air-vesicles. Pistillate flowers or young cones, sub-terminal or lateral, solitary or in clusters, surrounded at the base by sterile bracts; composed of two series of scales, minute carpels becoming obsolete in the ripe cone, and large ovuliferous scales, each of the latter bearing two pendulous ovules. Pollination occurs in the first year, when the scales open to receive the pollen, closing immediately afterwards; but fertilisation, the arrival of the pollen-tube at the embryo-sac, does not occur till May or June in the second year; in consequence the cone remains small in the first year, and increases only in size in the second year.

Fruit a woody cone,[4] ripening in nearly all the species[5] at the end of the second year; symmetrical, or oblique with the scales larger on the outer side of the cone. The exposed part of each scale in the unopened cone, known as the *apophysis*, is thickened and shows the apex of the growth of the first year as a terminal or dorsal protuberance or scar called the *umbo*, which is either unarmed or provided with a sharp prickle or stout spine. The cones in most species open their scales when ripe, allowing the seed to escape; but in *P. Cembra*, *P. pumila*, and *P. albicaulis* the scales are incapable of dehiscence, and the seeds are liberated by the attacks of squirrels and other animals. In other species a large proportion of the cones remain on the trees unopened for many years, the scales ultimately separating when scorched by forest fires. Usually the cones fall through decay at the insertion of their peduncle; but in *P. resinosa*, *P. ponderosa* and *P. palustris* separation occurs near the base of the cone, a few of the lower scales remaining attached by the stalk to the branch.

---

[1] In the species with leaves densely crowded on the branchlets, the scale-leaves persist during the first year.

[2] In *P. monophylla*, the section of the solitary leaf is terete.

[3] Shaw, *Pines of Mexico*, 1 (1909), points out that in the Soft Pines the buds enclosing the staminate flowers are not sufficiently advanced at the end of the growing season to be distinguishable; but in the Hard Pines they are recognisable by their larger size. In the latter, the young staminate flowers are either (*a*) enclosed in the general outline of the bud, or (*b*) they form about the nodes of the bud characteristic enlargements, which are constant for each species.

[4] The subterminal, lateral, or pseudo-lateral position of the cone referred to in descriptions of species is, as already defined above, that of the young cone in the first year.

[5] In *P. Pinea*, *P. leiophylla*, and *P. chihuahuana* the cones take three years to ripen; and in these the umbo of the scale shows separate growths of the first and second years.

Seeds, two on each scale, obovate, triangular or cylindrical; wing embracing by its rim-like base the sides and part of the upper surface of the seed, and either separating freely from it as in the Hard Pines, or adhering closely and breaking off from it irregularly as in *P. Strobus* and its allies. In certain species, the seeds of which are edible and distributed by animals, the wing, no longer serving for flight, is either reduced to a mere vestige only visible on the upper surface of the seed, as in *P. Cembra* and its allies, or it is much shortened and reduced to a narrow lateral rim, which usually remains on the scale when the seed falls, as in *P. Pinea*, *P. cembroides*, *P. Bungeana*, and their allies.

In germination the shell of the seed, from which the wing has usually fallen, is raised as a hood on the top of the cotyledons,[1] which vary from three to eighteen in number and are usually triangular, flat, and green below, and keeled and marked with stomata above, entire in margin, acute or mucronate at the apex. The young stem elongating bears primordial leaves, in the axils of which the adult fascicled leaves are usually produced in the second year.

About eighty species of Pinus are known, distributed through the northern hemisphere from the Arctic circle to Central America, the West Indies, Canary Islands, Morocco, Algeria, Syria, Himalayas, Burmah, Philippine Islands, Sumatra, and Borneo. Of these about fifty-two species are in cultivation, which may be arranged as follows:—

I. HAPLOXYLON, Koehne, *Deutsche Dendrologie*, 28 (1893). Soft Pines.[2]

Leaves with a single fibro-vascular bundle. Scale-leaves subtending the leaf-clusters inserted on prominent bases, which are not decurrent on the branchlets. Cones symmetrical, opening when ripe. Seed-wing present or obsolete, not readily detachable from the seed. Cortex persistent on young trees for many years. Walls of tracheids of medullary rays of the wood not dentate. The wood is usually soft, close-grained, and light in colour; sap wood generally narrow.

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[1] The number of cotyledons in each species is variable within narrow limits, and is stated by Dr. Masters in *Journ. Linn. Soc.* (*Bot.*) xxvii. 236 (1891). Cf. also Hill and de Fraine, in *Ann. Bot.* xxiii. 199 (1909).

[2] The shoots are always uninodal in the soft pines.

### A. LEAF-SHEATH ENTIRELY DECIDUOUS. LEAVES IN FIVES.

§ 1. STROBUS, Spach. White Pines.

Leaves serrate in margin, with marginal resin-canals. Cones sub-terminal, elongated, pendulous, usually long-stalked; scales thin, each with a terminal unarmed umbo. Seeds with long wings, closely adherent and breaking off irregularly.

* *Branchlets glabrous.*

1. *Pinus excelsa*, Wallich. Himalayas. See p. 1011.

Branchlets glaucous, green. Buds conic, shortly acuminate. Leaves 5 to 8 in. long, spreading, slender; some sharply bent as if broken.

2. *Pinus Peuke*, Grisebach. Balkan Peninsula. See p. 1014.

Branchlets shining green. Buds ovoid, shortly acuminate. Leaves about 4 in. long, densely tufted towards the end of the shoot, and not spreading or broken as in *P. excelsa*.

** *Branchlets pubescent. Bud-scales free at their apices.*

3. *Pinus Ayacahuite*, Ehrenberg. Mexico. See p. 1017.

Branchlets covered with a short rusty-brown pubescence. Buds ovoid, acuminate, resinous. Leaves 4 to 6 in. long, spreading, occasionally bent as if broken, as in *P. excelsa*.

*** *Branchlets pubescent. Bud-scales closely appressed.*

4. *Pinus Lambertiana*, Douglas. Oregon, California. See p. 1020.

Branchlets with short brown, partly glandular pubescence. Buds cylindrical, rounded at the apex or sharp-pointed. Leaves about 4 in. long, twisted a complete turn, rigid, ending in a sharp cartilaginous point.

5. *Pinus monticola*, Don. Western North America. See p. 1022.

Branchlets with short brown, partly glandular pubescence. Buds ovoid, acuminate. Leaves 4 in. long, slightly twisted in their upper half, blunt at the apex.

6. *Pinus Strobus*, Linnæus. Eastern North America. See p. 1025.

Branchlets with pubescent tufts below the insertions of the leaf-clusters, elsewhere usually glabrous. Buds ovoid, acuminate. Leaves 3 in. long, very slender, not twisted.

7. *Pinus parviflora*,[1] Siebold et Zuccarini. Japan, Kurile Isles. See p. 1033.

Branchlets greyish, with a scattered minute pubescence. Buds ovoid, not acuminate. Leaves 2 in. long, white on the inner surfaces, blunt at the apex.

§ 2. CEMBRA, Spach. Stone Pines.

Leaves serrate or entire in margin, with median or marginal resin-canals. Cones sub-terminal, short-stalked; scales thickened, each with a terminal unarmed umbo. Seeds large, edible, with rudimentary or obsolete wings.

---

[1] This species, which is variable in the length of the seed-wing, is intermediate in character, and forms a connecting link between the first two sections.

* *Leaves serrate, with median resin-canals.*

8. *Pinus Cembra*, Linnæus. Alps, Carpathians, North-Eastern Russia, Siberia. See p. 1035.

Branchlets covered with a dense orange-brown shaggy tomentum. Buds ovoid, acuminate, resinous. Leaves 2½ to 3½ in. long, with few serrations at the tip.

9. *Pinus koraiensis*, Siebold et Zuccarini. Amurland, Manchuria, Korea, Japan. See p. 1041.

Branchlets and buds as in *P. Cembra.* Leaves with numerous sharp serrations at the tip, otherwise as in *P. Cembra.*

10. *Pinus Armandi*, Franchet. China. See p. 1043.

Branchlets olive green, glabrous or with minute scattered hairs. Buds with free or appressed scales. Leaves 4 to 6 in. long, spreading, and often bent, as in *P. excelsa.*

** *Leaves entire in margin, with marginal resin-canals.*

11. *Pinus pumila*, Regel. Kamtschatka, Eastern Siberia, Amurland, Saghalien, Kurile Isles, Japan. See p. 1045.

Buds and branchlets as in *P. Cembra.* Leaves[1] also similar, but usually shorter and differing in the position of the resin-canals.

12. *Pinus flexilis*, James. Western North America. See p. 1046.

Branchlets glabrous or covered with a minute brown soft pubescence. Buds ovoid, sharp-pointed, resinous. Leaves 2 to 3 in. long, stout, rigid, curved, sharp-pointed.

13. *Pinus albicaulis*, Engelmann. Western North America. See p. 1048.

Scarcely distinguishable from *P. flexilis* in the absence of cones, though the branchlets apparently differ in their scattered minute stiff pubescence.

## B. Leaf-sheath entirely deciduous. Leaves in threes.

### § 3. Gerardianæ, Engelmann. Plane-bark Pines.

Leaves serrulate, with marginal resin-canals. Cones sub-terminal; scales much thickened, each with a dorsal umbo. Seeds large, edible; wing reduced to a narrow deciduous rim, remaining on the scale when the seed falls.

14. *Pinus Bungeana*, Zuccarini. China. See p. 1050.

Branchlets glabrous, green, smooth. Buds spindle-shaped, with scales free at their tips. Leaves 3 in. long, shining green, rigid, with the basal sheaths deciduous in the first year.

15. *Pinus Gerardiana*, Wallich. Western Himalayas. See p. 1052.

Branchlets glabrous, green, smooth. Buds conic, acuminate, resinous. Leaves 3 to 4 in. long, duller in colour and less rigid than in *P. Bungeana*, with the basal sheaths deciduous in the second year.

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[1] In the insular form of this species, the leaves are indistinctly serrulate in margin.

C. LEAF-SHEATHS PARTLY DECIDUOUS, THEIR INNER PART PERSISTING AS A ROSETTE OF REFLEXED SCALES AROUND THE BASE OF THE LEAF-BUNDLE. LEAVES ENTIRE IN MARGIN.

* *Leaves in fives.*

§ 4. BALFOURIANÆ, Engelmann. Fox-tail Pines.

Cones sub-terminal, short-stalked,[1] cylindrical; scales each with a dorsal umbo, armed with a slender prickle. Seeds with long wings, easily separable.

16. *Pinus Balfouriana*, Balfour. California. See p. 1054.

Branchlets stout, pubescent. Buds ovoid, acuminate. Leaves 1½ in. long, without stomata on the outer surface, rigid, curved.

17. *Pinus aristata*, Engelmann. Colorado, Utah, Nevada, Arizona, South-eastern California. See p. 1055.

Differs from the preceding species in the numerous resinous exudations on the leaves, and in the cones and seeds.

** *Leaves solitary or in twos, threes, or fours.*

§ 5. CEMBROIDES, Engelmann. Nut Pines.

Cones sub-terminal, sub-sessile, globose; scales few, much thickened, each with a dorsal umbo, unarmed or with a minute prickle. Seed large, edible, with wing reduced to a narrow rim, remaining on the scale.

18. *Pinus monophylla*, Torrey. Utah, Nevada, Arizona, California, Lower California. See p. 1056.

Leaves solitary, rigid, terete, sharp-pointed, 1½ in. long, remotely placed on the branchlets.

19. *Pinus edulis*, Engelmann. Wyoming, Colorado, Utah, New Mexico, Texas, Arizona, Northern Mexico. See p. 1058.

Leaves in twos, rarely in threes, rigid, sharp-pointed, ¾ to 1½ in. long, remotely placed on the branchlets.

20. *Pinus cembroides*, Zuccarini. Arizona, Lower California, Northern Mexico. See p. 1059.

Leaves in threes, rarely in twos, softer and more slender than in the other species of the section, and densely crowded on the branchlets.

21. *Pinus Parryana*, Engelmann. Southern California, Lower California. See p. 1060.

Leaves in fours, rarely in fives, 1½ in. long, rigid, sharp-pointed, remotely placed on the branchlets.

II. DIPLOXYLON, Koehne, *Deutsche Dendrologie*, 30 (1893). Hard Pines.

Leaves with a divided fibro-vascular bundle. Bases of the scale-leaves subtending the leaf-clusters, decurrent on the branchlets. Cones sometimes asymmetrical, and often remaining closed for several years after ripening; scales always with dorsal umbos. Seed-wing present, occasionally reduced to a narrow rim; always readily detachable from the seed. Walls of tracheids of the medullary rays of the wood ~~not~~ dentate. The wood is usually heavy, coarse-grained, and dark-coloured; sapwood thick, and paler in colour than the heartwood.

D. LEAF-SHEAF PERSISTENT IN ALL THE CULTIVATED SPECIES. LEAVES ALWAYS SERRATE.

*a. Leaves in fives.*

§ 6. PSEUDOSTROBUS, Engelmann. Leaves with median resin-canals. Cones sub-terminal. Shoots uninodal.

22. *Pinus Montezumæ*, Lambert. Mexico, Guatemala. See p. 1061.

Branchlets stout, not glaucous, reddish brown. Buds ovoid, pointed, an inch long, reddish brown, scarcely resinous. Leaves about 9 in. long; basal sheaths 1¼ to 2 in. long. Scale-leaves persistent.

22A. *Pinus Montezumæ*, Lambert, var. *Hartwegii*, Engelmann. Cold regions and high altitudes of Mexico. See p. 1062.

Branchlets and buds, as in the type, but the latter smaller, ½ to ¾ in. long, usually with resinous appressed scales. Leaves 5 to 6 in. long; basal sheaths 1 in. long. Scale-leaves persistent.

23. *Pinus pseudostrobus*, Lindley. Mexico. See p. 1064.

Branchlets slender, glaucous. Buds, leaves, and scale-leaves as in *P. Montezumæ*.

24. *Pinus Torreyana*, Parry. Coast of California near San Diego, and Santa Rosa island. See p. 1065.

Branchlets glaucous, dull grey in the second year. Buds cylindro-conic, ½ in. long; scales pale brown with appressed points. Leaves 7 to 13 in. long, very stout; basal sheaths an inch long. Scale-leaves deciduous.

*β. Leaves in threes.*

§ 7. TAEDA, Mayr.

Leaves with median resin-canals. Cones variable in size and position. Shoots uninodal or multinodal.

* *Buds resinous; points of bud-scales appressed.*

† *Leaves more than* 6 *in. long.*

25. *Pinus Coulteri*, Don. California. See p. 1067.

Branchlets stout, glaucous, remaining green in the second year. Buds ovoid, stout, acuminate or cuspidate, 1 to 1½ in. long. Leaves 10 to 14 in. long, dark green, spreading from the upper part of the branchlets of the first and second years.

26. *Pinus Sabiniana*, Douglas. California. See p. 1069.

Branchlets slender, glaucous, remaining green in the second year. Buds narrowly cylindrical, an inch long. Leaves 7 to 12 in. long, greyish green, spreading or drooping from the upper part of the branchlets of the first and second years.

27. *Pinus ponderosa*, Lawson. Western N. America. See p. 1071.

Branchlets stout, reddish, not glaucous, becoming nearly black in the second and third years. Buds cylindro-conic, an inch long. Leaves 6 to 10 in. long, dark green, densely crowded on the greater part of the branchlets, directed outwards and forwards.

27A. *Pinus ponderosa*, Lawson, var. *Jeffreyi*, Vasey. California and Lower California. See p. 1072.

Branchlets stout, glaucous, becoming dark-coloured in the second and third years. Buds stout, cylindro-conic, reddish brown, an inch long, with scales less resinous and their points more free than in the type.

†† *Leaves less than* 6 *in. long.*

28. *Pinus tuberculata*, Gordon. Oregon, California. See p. 1077.

Branchlets reddish brown, not glaucous. Buds cylindrical, pointed, an inch long. Leaves 4 to 5 in. long, rigid, dark green; basal sheath ½ in. long.

29. *Pinus radiata*, Don. Coast of California, near Monterey. Islands of Santa Cruz, Santa Rosa, and Guadalupe. See p. 1079.

Branchlets reddish brown, not glaucous. Buds cylindrical, pointed, ½ to ¾ in. long. Leaves 4 to 5 in. long, slender, flexible and soft in texture, light green, densely crowded on the branchlets; basal sheath ½ inch long.

** *Points of the bud-scales free and slightly spreading, not reflexed.*

30. *Pinus patula*, Schlechtendal et Chamisso. Mexico. See p. 1085.

Branchlets glaucous. Buds cylindro-conic, ½ to ¾ in. long. Leaves 6 to 9 in. long, filiform, soft and very slender, drooping; basal sheath, 1 in. long.

31. *Pinus Teocote*, Schlechtendal et Chamisso. Mexico. See p. 1086.

Branchlets glaucous, the epidermis of the decurrent pulvini peeling off in the second and third years. Buds cylindro-conic, resinous, ¾ in. long. Leaves 4 to 8 in. long, rigid, spreading; basal sheath an inch long.

32. *Pinus rigida*,[1] Miller. Eastern Canada, and North-eastern United States. See p. 1087.

Branchlets not glaucous. Buds cylindro-conic, ½ to ¾ in. long. Leaves 3½ to 4 in. long, rigid; basal sheath ⅜ to ½ in. long.

33. *Pinus serotina*,[1] Michaux. South-eastern and Southern United States. See p. 1090.

Distinguishable from *P. rigida* by the different cones and longer leaves, 6 to 10 in. long; but in cultivated trees in England the leaves are as short as in that species.

*** *Buds non-resinous; bud-scales with free, fimbriated, and recurved points. The apex of the second year's branchlet is marked with a conspicuous sheath of the persistent recurved bud-scales.*

34. *Pinus palustris*, Miller. South-eastern and Southern United States. See p. 1091.

Branchlets stout, orange brown. Buds 1½ to 2 in. long, with silvery white scales. Leaves 8 to 18 in. long, densely crowded on the branchlets; basal sheath ¾ to 1 in. long. Scale-leaves persistent.

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[1] Adult trees of both these species are readily recognisable by the adventitious shoots on the old branches and stems. Occasionally the buds in *P. rigida* are very resinous, with closely appressed scales.

35. *Pinus Taeda*, Linnæus. South-eastern and Southern United States. See p. 1094.

Branchlets glaucous. Buds ½ in. long, with brown scales. Leaves 6 to 9 in. long, spreading; basal sheath nearly 1 in. long. Scale-leaves persistent.

36. *Pinus canariensis*, Smith. Canary Islands. See p. 1096.

Branchlets yellow, not glaucous. Buds ¾ in. long, with reddish brown scales. Leaves 7 to 12 in. long, densely crowded on the branchlets, slender, flexible.

γ. *Leaves in twos; in one species, clusters of three leaves also occur.*
See § 8 and § 9.

§ 8. BANKSIA, Mayr.

Cones lateral. Shoots multinodal, a vigorous branch showing a whorl of buds, branchlets, or cones in the middle of each year's shoot, in addition to the subterminal whorl.

* *Leaves in twos and in threes, on the same branch.*

37. *Pinus echinata*, Miller. South-eastern United States. See p. 1098.

Branchlets slender, brittle, glaucous, with the bark in the third year exfoliating in large flakes. Buds ¼ in. long, brownish, shining, with resinous appressed scales. Leaves 3 in. long, resin-canals median; basal sheath ⅜ in. long.

** *Leaves always in pairs.*

† *Buds non-resinous, with free and recurved points to their scales.*

38. *Pinus halepensis*, Miller. Mediterranean region, Caucasus. See p. 1099.

Branchlets glaucous. Leaves 2½ to 4 in. long; resin-canals marginal; basal sheath ⅓ in. long. In var. *Brutia* the leaves are 4 to 6 in. long.

†† *Buds resinous, with appressed scales.*

39. *Pinus muricata*, Don. California. See p. 1104.

Branchlets stout, reddish brown. Buds cylindrical, ¾ to 1 in. long; scales encrusted with white resin. Leaves 4 to 6 in. long, stout, rigid; resin-canals median; basal sheath ½ in. long.

40. *Pinus pungens*, Michaux. Alleghany Mountains. See p. 1106.

Branchlets shining brown. Buds cylindrical, ¾ in. long. Leaves 2 to 2½ in. long, stout, rigid, very sharp-pointed; resin-canals median; basal sheath ¼ in. long.

41. *Pinus virginiana*, Miller. Eastern United States. See p. 1107.

Branchlets slender, glaucous violet. Buds cylindrical, ⅜ in. long. Leaves 1½ to 3 in. long; resin-canals median; basal sheath 3/16 in. long.

42. *Pinus Banksiana*, Lambert. Canada, east of the Rockies; United States, Minnesota to Maine. See p. 1109.

Branchlets slender, greenish. Buds ovoid, ½ in. long. Leaves 1 in. long; resin-canals median; basal sheath ⅛ to ⅙ in. long.

§ 9. PINASTER, Mayr.

Cones subterminal. Shoots uninodal, a branch, even when vigorous, showing only one whorl of branchlets, buds, and cones, in each year's shoot, close to its apex. Leaves always in pairs.

* *Buds non-resinous; bud-scales with free and recurved points.*

43. *Pinus Pinaster*, Solander. Mediterranean region. See p. 1113.

Branchlets stout. Buds stout, spindle-shaped, pointed, ¾ to 1 in. long. Leaves 5 to 6 in. long, stout, rigid; resin-canals marginal; basal sheath 1 in. long.

44. *Pinus Pinea*, Linnæus. Mediterranean region. See p. 1119.

Branchlets slender. Buds ovoid, pointed, ⅜ in. long. Leaves 4 to 5 in. long; resin-canals marginal; basal sheath 4/10 in. long.

** *Buds resinous; bud-scales free at the apex. Bark of upper part of the stem reddish and peeling off in thin papery scales.*

45. *Pinus sylvestris*, Linnæus. Europe, Asia Minor, Caucasus, Siberia. See Vol. III. p. 571.

Branchlets shining, greenish. Leaves 2 to 3 in. long, glaucous blue, broad and flattened; resin-canals marginal; basal sheath ⅓ in. long.

46. *Pinus densiflora*, Siebold et Zuccarini. Japan. See p. 1125.

Branchlets glaucous. Buds ½ in. long. Leaves 3 to 4 in. long, dull green; resin-canals marginal; basal sheath ⅜ in. long, often ending in two long narrow filaments.

*** *Buds resinous; points of the bud-scales appressed.*

† *Buds cylindric or spindle-shaped. Leaves 1½ to 3 in. long.*

47. *Pinus montana*, Miller. Mountains of central and southern Europe. See p. 1127.

Branchlets brown. Buds ¼ to ½ in. long, very resinous. Leaves persistent 5 to 10 years, 1½ to 2½ in. long; resin-canals marginal; basal sheath ½ to 6/10 in. long.

48. *Pinus contorta*, Loudon. Western North America. See p. 1134.

Branchlets brown. Buds ½ in. long, very resinous. Leaves persistent 3 to 8 years, twisted, 1½ to 3 in. long; resin canals median; basal sheath ¼ in. long.

†† *Buds ovoid. Leaves*[1] *3 to 6 in. long.*

49. *Pinus resinosa*, Solander. Eastern Canada; United States, Minnesota to Massachussets. See p. 1140.

Branchlets orange-brown. Buds pale brown, ½ to ¾ in. long. Leaves 5 to 6 in. long; resin-canals marginal; basal sheath ⅞ in. long.

50. *Pinus Thunbergii*, Parlatore. Japan. See p. 1143.

Branchlets brown. Buds ½ to ¾ in. long, whitish. Leaves 3 to 4 in. long, rigid, sharp-pointed; resin-canals median; basal sheath ½ in. long, ending above in two long filaments.

51. *Pinus Laricio*, Poiret. Southern Europe, Caucasus, Asia Minor. See Vol. II. p. 407.

Branchlets brown. Buds ½ to 1 in. long, light brown, tinged with white. Leaves 4 to 6 in. long; resin-canals median; basal sheath ½ in. long.

52. *Pinus leucodermis*, Antoine. Bosnia, Herzegovina, Montenegro. See Vol. II. p. 424.

Branchlets glaucous. Buds ½ to 1 in. long, dark brown. Leaves 2 to 3 in. long, rigid, sharp-pointed; resin-canals median; basal sheath ½ in. long.

(A. H.)

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[1] They are sometimes only 2 in. long in *P. leucodermis*, No. 52.

## PINUS EXCELSA, HIMALAYAN BLUE PINE

*Pinus excelsa*, Wallich, *List* 6059 (1828), and *Pl. As. Rar.* iii. t. 201 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2285 (1838); Forbes, *Pinet. Woburn.* 75, t. 29 (1839); Masters, *Gard. Chron.* xix. 244, figs. 32, 35 (1883), and *Journ. Linn. Soc.* (*Bot.*), xxxv. 581 (1904); Lawson, *Pinet. Brit.* i. 27, t. 4 (1884); Hooker, *Fl. Brit. India*, v. 651 (1888); Kent, Veitch's *Man. Coniferæ*, 328 (1900); Gamble, *Man. Indian Timbers*, 704 (1902); Brandis, *Indian Trees*, 689 (1906); Clinton-Baker, *Illust. Conif.* i. 20 (1909).

*Pinus nepalensis*, De Chambray, *Traité Prat. Arb. Rés. Conif.* 312 (1845).

*Pinus pendula*, Griffith, *Journals*, 211, 237, 239, 264, 265, 287, 293 (1847).

*Pinus Griffithii*, M'Clelland, in Griffith, *Notul.* iv. 17 (1854), and *Icon. Pl. Asiat.* iv. t. 365 (1854).

A tree, attaining in the Himalayas 150 ft. in height and 12 ft. in girth. Branches widely spreading; branchlets upturned at their tips. Bark greyish brown, smooth on young trees, ultimately fissuring into small regular plates. Buds conical, elongated, shortly acuminate; the long subulate points of the scales either free or appressed together with resin. Young branchlets glaucous, smooth, glabrous, turning olive green in winter, and dark grey in the second year.

Leaves in fives, persisting for three years, 5 to 8 in. long, spreading, often bent near the base, as if broken; slender, scarcely curved or twisted, serrulate, sharp-pointed, marked with stomatic lines on the three surfaces; resin-canals marginal; basal sheath ¾ in. long, early deciduous.

Cones solitary or two to three together, erect when young, pendulous in the second year on stalks 1¼ to 2 in. long; cylindrical, 6 to 10 in. long, light brown when mature. Scales elongated-cuneate, about 1½ in. long, 1 in. broad at the widest part; apophysis longitudinally channelled, convex from side to side, and thickened in the centre, with rounded thin upper margin, and short pointed terminal dark coloured umbo. Seed ovoid, brown, ¼ to $\frac{5}{16}$ in. long; wing ⅞ in. long, ⅜ in. wide, very oblique on the outer side, light brown, streaked with darker brown wavy lines. Cotyledons 8 to 12.

This species is readily distinguishable from all the other pines with five leaves and a deciduous sheath, by its glabrous glaucous branchlets.

Striped[1] and one-leafed[2] sports, arising in cultivation, have been described; but appear to be unknown in England.

### DISTRIBUTION

This species,[3] known as the blue pine in India, is a native of the temperate Himalayas, at 6000 to 12,500 feet elevation, extending westward to Afghanistan and Kafiristan, and eastward to Nepal, but has not been seen in central and north-west Kumaon. It has not been found in Sikkim, but is common in Bhutan.[4] According to

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[1] Var. *zebrina*, Croux, in *Rev. Hort.*, 1889, p. 392, fig. 101. Leaves marked an inch below the apex with a cream-coloured band. Originated at Sceaux in France.

[2] Var. *monophylla*, Carrière, *Conif.* 398 (1867). Each sheath with apparently only one leaf, all the five leaves being welded together.

[3] It was first collected by Buchanan-Hamilton near Narainhetty, in Nepal.

[4] Hooker and Thomson, *Fl. Indica, Introductory Essay*, 178, 181 (1855), and Griffith, *Journ. Mission Bootan in 1837-1838*, p. 129.

Gamble it either forms pure woods or is mixed with other trees, such as the deodar, being accompanied at high levels by birch and silver fir, and at low elevations by *Pinus longifolia*. On the edges of the forest, scrub lands soon become covered with seedlings, which grow up into dense belts. These seedlings, on account of their rapid growth, soon suppress those of the deodar. Mayr[1] refers to the ease with which this pine naturally regenerates itself in the Himalayas, and gives a picture of the forest with numerous seedlings.

It commonly attains a height of 100 to 120 ft., with a girth of 6 to 10 ft., rarely reaching 150 ft. in height and 12 ft. in girth. On good soils at moderate elevations, it grows rapidly, making five rings per inch of radius; while at high elevations on rocky soil its rate sinks to 20 to 25 rings per inch. It prefers sandy or clayey soils, though occasionally met with on limestone. In India, while easy to rear in the nursery, it bears transplanting badly; and Gamble recommends that it should be grown in baskets, which should be used in planting out.

The timber is good, next in value to that of the deodar, and is largely used in construction throughout the western Himalayas, especially in Kashmir and the Punjab. For railway sleepers it is slightly inferior to the deodar; but for planking, doors, windows, and furniture, it is better than the timber of that tree, as it is not so brittle, and is free from the oil, which in the deodar so readily absorbs dirt. In Kangra and Kulu, it is said to be used for making tea-boxes, as it is free from strong scent.[2]

The wood is highly resinous, and produces turpentine and tar.[2] The trees are tapped for about three years, then allowed three years' rest, when tapping is recommenced on the other side. The more resinous parts of the wood are much employed for torches, known as *mashál* in Hindustani.

In dry winter seasons, the leaves and twigs become covered with a copious sweet exudation, which is collected and eaten by the natives. The origin of this manna-like substance is not yet accurately determined.[3] (A. H.)

## CULTIVATION

*P. excelsa* was introduced into cultivation[4] by Lambert, who raised many plants in 1823 at Boyton. Plants were also reared in the Chiswick Garden and in the Glasgow Botanic Garden in 1827 from seeds sent by Wallich.

It is perfectly hardy in all parts of Great Britain, Mr. Palmer's tables showing only five places out of ninety-five in which it was killed by the severe winter of 1860, and in three of these the thermometer fell below zero. Two-year seedlings raised at Colesborne from Himalayan seed were uninjured in my garden in 1908 by a temperature of about zero. But judging from its comparative rarity, and the smaller size of the trees we have seen in the north of England and in Scotland, it requires the full summer heat of our climate to do it justice, nearly all the largest specimens I have seen being in the south and east, not attaining such large dimensions where the winters are very mild. It seems comparatively indifferent to soil, growing best on a good deep loam, and is one of the pines which may be planted on limestone successfully.

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[1] *Fremdländ. Wald- u. Parkbäume*, 375, fig. 122 (1906).

[2] Cf. Watt, *Commercial Products of India*, 888 (1908), who refers to Thurston, *Resin and Turpentine from Indian Pines, Imp. Inst. Handbook*, 1893, pp. 7-19; Lawrence, *Valley of Kashmir*, 80 (1895); etc.

[3] Cf. Madden, in *Journ. Agri-Hort. Soc. India*, reproduced in *Indian Forester*, i. 55 (1875).

[4] *Genus Pinus*, ii. 6 (1824).

As a rule it seems to have a tendency to fork low down, and often develops into large spreading bushy trees with several leaders, and the lower branches resting on the ground. Its growth when young is rapid, but seems to fall off very much after forty or fifty years. It is liable to be injured by wind, and requires a sheltered situation, with full sun. I am not aware that it has anywhere been tried under forest conditions, and it has no special qualities that will justify its being looked on as other than an ornamental tree. It produces seed freely, which sheds early, and in favourable situations reproduces itself naturally.

### Remarkable Trees

The best specimen as regards height and symmetry that I have seen is at Hewell Grange, near Bewdley, the seat of the Earl of Plymouth, which in 1909 measured 93 ft. by 8 ft. 4 in. There are two fine trees growing on low ground near the lake at Eastnor Castle, with tall oaks and elms near them. Mr. Mullins, the gardener, measured these in 1909, by sending a man up the stems to near the top, and found them to be 90 ft. by 7 ft. 11 in., and 80 ft. by 8½ ft.

A tree at the Hendre, Monmouthshire, is said by Sir H. Maxwell[1] to be 90 ft. high. A well-shaped tree near the mansion at Claremont was 81 ft. by 8 ft. in 1907. A tree at Nuneham Park was 74 ft. by 8 ft. 7 in. in 1907. A large tree forking close to the ground, where some of the branches have layered, about 60 ft. by 8 ft., is growing at Goodwood. At Ampney Crucis, near Cirencester, on the lawn of the house occupied by Mrs. Elwes, a tall slender tree was about 68 ft. by 4 ft. in 1909. At Highnam, Gloucester, a tree measured in 1906, 63 ft. by 8 ft. 5 in. At Wilton House, near Salisbury, a tree was 77 ft. by 8 ft. 3 in. in 1906.

At Merton, Norfolk, there is a tall tree, dividing near the base into four stems which reach a height of 86 ft. This was raised from seed in 1861. At Munden, Watford, a fine tree is 75 ft. high, girthing 9 ft. at two feet from the ground, and dividing above into two stems. There is a very remarkable specimen at The Frythe, Welwyn, which was planted in 1846. It is 60 ft. high and 7 ft. in girth, with extremely wide spreading branches, many layering and sending up erect stems. The total circumference of the branches was 246 ft. in 1906. Mr. H. Clinton-Baker measured a tree at High Canons, Herts, 75 ft. by 7 ft. in 1908.

Another is that at Barton, near Bury St. Edmunds, which measured in 1904, 87 ft. by 9 ft. 5 in. It was raised[2] from seed given to Lady Napier by Wallich, and was planted out in 1843. It bore the severe winter of 1860-1861 without injury. There is a large tree at Casewick, Stamford, from which Lord Kesteven has raised numerous seedlings. At Wimpole, near Cambridge, a well-shaped tree measured 63 ft. by 7 ft. 3 in. in 1909.

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[1] Green, *Encyl. Agr.* iii. 280 (1908).

[2] Bunbury, *Arboretum Notes*, 131 (1889).

In Wales the largest I have seen is an ill-grown tree, at Maesllwch Castle, forking at the ground, where it was 10 ft. 10 in. in girth in 1906.

In Scotland the finest tree[1] is probably one at Smeaton-Hepburn, planted in 1839, which was 76 ft. high in 1902, with a trunk 12 ft. in girth at two feet from the ground, dividing above into three stems. At Keir, Perthshire, a fine tree measured 67 ft. by 6 ft. 3 in. in 1903. At Galloway House, Wigtownshire, there is a healthy tree, about 40 ft. in height.

In Ireland, there is a fine wide-spreading tree at Kilruddery, near Bray, which in 1904 measured 65 ft. by 9 ft. 4 in. There are also good specimens at Castlemartyr. At Brockley Park, Queen's County, a tree, dividing into several stems near the base, was 64 ft. high in 1907. At Emo Park, Portarlington, another measured, in the same year, 66 ft. by 6 ft. 9 in.

Sargent[2] says that in New England it is hardy though short-lived; but there are large, healthy cone-bearing trees in Central Park, New York, and near many cities of the middle states. (H. J. E.)

## PINUS PEUKE, MACEDONIAN PINE

*Pinus Peuke*, Grisebach, *Spicileg. Flor. Rumel.* ii. 349 (1844); Christ, in *Flora*, xlviii. 257, t. 2 (1865); Boissier, *Flora Orientalis*, v. 698 (1884); Masters, in *Gard. Chron.* xix. 244, figs. 33, 34 (1883), and in *Journ. Linn. Soc.* (*Bot.*), xxii. 205, figs. 30, 31 (1887), and xxxv. 581 (1904); Kent, Veitch's *Man. Conif.* 357 (1900); Beck von Mannagetta, *Vegetationsverhält. Illyrischen Ländern*, 363-365 (1901); Clinton-Baker, *Illust. Conif.* i. 42 (1909).

*Pinus excelsa*, J. D. Hooker, *Journ. Linn. Soc.* (*Bot.*), viii. 145 (1864) (not Wallich).

*Pinus excelsa*, Wallich, var. *Peuce*, Beissner, *Nadelholzkunde*, 286 (1891).

A tree, attaining in Bulgaria 100 ft. in height and 7 ft. in girth, narrowly pyramidal in habit. Bark similar to that of *P. excelsa.* Buds ovoid, shortly acuminate, about ⅜ in. long, brown, resinous; scales with long subulate free points. Young branchlets smooth, glabrous, shining green, becoming brownish grey in the second year.

Leaves in fives, persistent two or three years, about 4 inches long, directed forwards and slightly outwards, not widely spreading or bent as in *P. excelsa*, slender, straight, not twisted, serrulate, sharp-pointed, marked with stomatic lines on all three surfaces; resin-canals marginal; basal sheath ¾ in. long, early deciduous.

Cones on short (less than ½ in.) stalks, subterminal, spreading or pendulous, green before ripening, brown when mature, cylindric, tapering to a blunt apex, 4 to 6 in. long, 1½ to 2 in. in diameter. Scales broadly cuneate, thin, 1¼ to 1½ in. long, ¾ in. broad; apophysis slightly rounded or almost straight in the thin bevelled upper margin, raised in the centre and marked exteriorly with longitudinal channels, convex from side to side, ending in a small dark-coloured depressed umbo. Seed similar to that of *P. excelsa*, but with a shorter broader wing, which has finer, closer, and straighter longitudinal veins.

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[1] Cf. *Hist. Berwickshire Nat. Club*, xviii. 211 (1904).

[2] *Garden and Forest*, x. 461 (1897).

Specimens from the Balkans, with shorter thinner leaves than those first described from Mt. Peristeri, were distinguished by Dr. Christ as var. *vermiculata*[1]; but such trivial and inconstant differences scarcely deserve a varietal name.

This species is closely allied to *P. excelsa*, but differs remarkably in the narrow pyramidal habit seen both in cultivation and in Bulgaria, where, as Velenovsky states, natural woods look exactly like plantations of Weymouth pine. It has shorter stiffer leaves, more or less appressed to the branchlets, and not spreading or bent as in *P. excelsa*. The green glabrous branchlets distinguish *P. Peuke* from all other species of the *Strobus* and *Cembra* sections.

## DISTRIBUTION

This pine has a limited distribution, being confined to three small areas, in Bulgaria, Macedonia, and Montenegro. The largest of these is on the confines of Bulgaria and Macedonia, where the tree is known as *Mura*, and occurs on the Rilo Mountains, on the Mussala Mountain in the Rhodope range, and in the Perim range in Macedonia. Here it forms woods of considerable extent, which extend low down into the valleys, where it is mixed with *Pinus sylvestris*, and ascend up to the alpine zone, where it is associated with *Pinus montana*, var. *mughus*. According to Velenovsky,[2] trees 100 years old are growing on the Rilo and Mussala Mountains, which are 100 ft. in height and 5 to 7 ft. in girth. There are specimens in the Kew herbarium, which were collected on the Rilo Mountains in June 1899 by Elwes.

The second area of distribution is confined to Mt. Peristeri, above Monastir (lat. 41°, long. 21°), where the species was first discovered in 1839 by Grisebach. The small forest on this mountain, situated on granite soil between 2400 and 5800 ft. altitude, consisted of pines growing rather scattered amongst a dense undergrowth of juniper, and of no great size, scarcely exceeding 40 ft. in height at the lower levels, and becoming mere bushes, 4 ft. in height, at the higher elevations. Orphanides rediscovered the tree on Mt. Peristeri in 1863, and records it as growing between 3000 and 6000 ft. altitude. Halacsy[3] is of opinion that its occurrence on the mountains of northern Thessaly is probable, but as yet uncertain.

The third locality is in Montenegro, close to the Albanian frontier, where the tree is known as *Molika*, and occupies a narrow strip of territory, about 22 miles in length, extending from west to east through the mountains, in which the river Lim takes it origin. It is recorded from the high ridge between the valleys of the Perućica and Vermoša rivers in the Kom Mountains, and on the Zeletin, Zjekirica, and Šekular Mountains. According to Beck, the tree is not found on the north Albanian Alps, as these are composed of limestone, on which it never grows in the wild state. In Montenegro it is not much affected by the great differences in climate throughout its extensive range of elevation, 2600 to 6300 ft., in which three species of juniper are found, each confined to a distinct zone of altitude. It assumes a bushy habit both at the lower levels and on the highest parts of the mountains, and never forms pure woods, growing scattered amidst other trees, and only attaining 30 to 45 ft. in height.

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[1] *Ex* Beissner, *Nadelholzkunde*, 286 (1891).

[2] *Flora Bulgarica*, 518 (1891), and *ibid.*, *Suppl.* i. 333 (1898).

[3] *Consp. Floræ Græcæ*, iii. 451 (1904).

### CULTIVATION

This species was introduced by Orphanides, who gathered ripe seeds on Mt. Peristeri in 1863, which were distributed by Messrs. Haage and Schmidt[1] of Erfurt.

Through the kind offices of Pierce O'Mahony, Esq., I received a large quantity of seed from King Ferdinand of Bulgaria in April 1908. This has been widely distributed to different friends throughout England, Ireland, and Scotland. Most of it was tardy in germination, and the seed came up irregularly, some not germinating until 1909.[2]

The finest tree known to us in England is one at Bicton, which, when measured by Elwes in 1906, was 42 ft. high by 3 ft. 8 in. in girth, and was bearing cones. There is also a good one at Grayswood, 36 ft. by 3½ ft., planted in 1881; and one at The Heath, Leighton Buzzard, 37 ft. by 2 ft. 10 in., both measured by Mr. A. B. Jackson in 1908.

A group of healthy trees are growing in Kew gardens, near the Isleworth Ferry gate, which were raised from seed of the original importation sown in 1864. These trees have a thriving appearance, and the largest one measured, in 1909, 42½ ft. by 3 ft. 10 in.

At Westonbirt there are several trees 30 to 35 ft. in height and a foot in diameter, growing beside a tree of *P. monticola*, about 50 ft. high and 15 in. in diameter, which was planted at the same time.

There are two trees at Galloway House, Wigtownshire, the larger of which measured, in 1908, 48 ft. by 4 ft. 9 in.; and a smaller tree is growing at Ochtertyre, Perthshire.

According to Mayr, *P. Peuke* is as fast in growth and as hardy in Germany as the Weymouth pine. It has withstood without injury the severe temperature of −22° Fahr. at Grafrath, near Munich, and for so far has not been attacked by *Agaricus melleus*. It may possibly also be immune to the pine blister (*Peridermium Strobi*), which is so destructive to the Weymouth pine in many places on the continent. For these reasons Mayr is inclined to recommend the immediate planting in Germany of *P. Peuke* in place of the Weymouth pine.

Elwes saw in the nursery of Regel and Kesselring at St. Petersburg in 1908 young trees of *P. Peuke* which on damp and sandy soil had attained 12 ft. high in twelve years, and had resisted 30 degrees centigrade of frost without injury. It seems, therefore, likely to become a valuable forest tree in central Europe.

In New England this species[3] is quite hardy in the Arnold Arboretum, where, however, Sargent says that it is a slow-growing tree of no especial ornamental value. (A. H.)

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[1] A letter of Haage and Schmidt to Lindley concerning the first seed of this pine, and dated 11th January 1864, is preserved in the Cambridge Herbarium.

[2] Mr. Storie reports from Highclere that about 300 plants came up in April 1909.

[3] *Garden and Forest*, x. 461 (1897).

## PINUS AYACAHUITE, Mexican White Pine

*Pinus Ayacahuite*,[1] Ehrenberg, *ex* Schlechtendal, in *Linnæa*, xii. 492 (1838); Loudon, *Encycl. Trees*, 1023 (1842); Masters, in *Gard. Chron.* xviii. 492, f. 83 (1882), in Lawson, *Pinetum Brit.* i. 9, t. 2 (1884), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 579 (1904); Kent, Veitch's *Man. Conif.* 311 (1900); Clinton-Baker, *Illust. Conif.* i. 8 (1909); Shaw, *Pines of Mexico*, 9, t. iv. (1909).

A tree attaining in Mexico 100 ft. or more in height and 12 ft. in girth, and in cultivation resembling *P. excelsa* in habit. Bark rough and scaly on old trees. Buds reddish brown, resinous, ovoid, acuminate, about ½ in. long; scales with long acuminate tips, usually free and directed upwards. Young branchlets covered with a short brown pubescence, occasionally confined to the parts below the insertions of the leaves; older branchlets glabrescent, and bright brown or greyish in colour.

Leaves in fives, spreading, usually persistent for three years, very slender or filiform, 4 to 8 in. long, serrulate, sharp-pointed, straight, scarcely twisted; outer surface green, with two or three short stomatic lines near the top; inner flat surfaces, each with three or four continuous white stomatic lines; resin-canals marginal; basal sheath ¾ in. long, early deciduous.

Cones sub-terminal, pendent, solitary, or in pairs, on stalks about ½ in. long, ovoid-cylindrical, often curved, gradually narrowing towards the obtuse apex, 8 to 18 in. long, 2½ to 6 in. wide towards the base, pale brown and resinous when mature. Scales about 2 or 3 in. long, and 1 to 1½ in. wide; apophysis rhomboidal or triangular, reflexed, ending in a swollen, rounded, inflexed or reflexed resinous tip. Seed ovoid, compressed, ⅜ in. long, brownish, mottled with dark streaks or spots; wing oblong, narrow, oblique, about ¾ in. long, pale brown, with longitudinal darker streaks.

This species so closely resembles *P. excelsa* in habit and foliage that possibly some of the trees passing under the latter name in cultivation may belong to it, but it is readily distinguished by the more slender leaves and the pubescent branchlets, which have in cultivated trees a reddish brown colour. It is quite distinct in cones and seeds.

### Varieties

This pine varies extremely in the size and shape of the cones, seeds, and seed-wings, and according to Shaw, comprises three distinct geographical races, which are however connected by numerous intermediate forms:—

1. Typical form, described above. Seed with a long narrow wing. Prevalent in Guatemala and the southern states of Mexico.

2. Var. *Veitchii*, Shaw, *Pines of Mexico*, 10, t. v. (1909).

*Pinus Veitchii*, Roezl,[2] *Cat. Gr. Conif. Mex.* 32 (1857).

*Pinus Bonapartea*, Roezl, in *Gard. Chron.* 1858, p. 358; Clinton-Baker, *Illust. Conif.* i. 12 (1909).

*Pinus Loudoniana*, Gordon, *Pinetum*, 230 (1858).

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[1] Roezl's *P. durangensis* is probably typical *P. Ayacahuite.*

[2] *P. Don Pedri*, *P. hamata*, and *P. Popocatepetli*, names given to certain cones by Roezl, belong to this variety.

Cones larger, as a rule, than in the type. Seed larger, ½ in. long, ovoid, compressed, dark brown or blackish; wing short and broad, about ½ in. long and wide, dark brown in colour. Prevalent in the central states of Mexico.[1]

3. Var. *brachyptera*, Shaw, *Pines of Mexico*, 11, t. vi. (1909).

*Pinus strobiformis*, Engelmann, in Wislizenus, *Tour N. Mexico*, 102 (1848).

Differs from the type, according to Shaw, in the larger seeds, with extremely short wings. Occurs in the states of Durango and Chihuahua, in northern Mexico.

## DISTRIBUTION

This pine, according to Shaw, is a native of cool temperate altitudes in Central America, and extends from Guatemala throughout Mexico to the borders of the United States.

The typical form of the species was discovered[2] by Ehrenberg in 1836 in Mexico, who found trees 100 feet high at Omitlan, near Hacienda de Guerrero, and appears to be common in Oaxaca, particularly on the higher points of the Cumbre Mountains and on Mount Pelado. Hartweg found it in Guatemala, where he observed dead trees on the volcano Xetul, near Quezaltenango, at 10,000 ft. elevation.

Var. *Veitchii* was discovered[3] by Roezl on the Sierra Madre range at 8600 ft. and at Tenango, and also on the eastern side of Mt. Popocatepetl at 11,000 to 12,000 ft., where it grows abundantly on the borders of deep ravines, never descending into the depths of the gorges, or ascending much above them. Here the winters are dry, the temperature descending to 10° to 14° Fahr., but the summers are long and warm. It is known to the Mexicans as *Ayacahuite colorado*, or red pine, on account of the excellence of its timber.

Var. *brachyptera* was discovered on the mountains of Cosihuiriachic in the province of Chihuahua, at about 8000 ft. elevation, where, according to Engelmann, it is a large tree, 100 to 130 ft. in height, with short leaves 2½ to 3 inches long, and very resinous cones about 10 in. in length. This northern form does not appear to have been introduced into cultivation. (A. H.)

## CULTIVATION

The typical form of the species was introduced into the Chiswick garden of the Horticultural Society by Hartweg in 1840, and seeds were again sent to this country by Roezl in 1857. It is comparatively rare in cultivation, and appears to succeed best in the south-west and west of England, Palmer's frost tables[4] showing that it was killed in 1860 at Thorpe Perrow in Yorkshire, and at Highnam Court in Gloucestershire.

At Westonbirt a tree, which produces cones freely, from the seed of which numerous seedlings have been raised at Kew and Glasnevin, measured in 1909, 62 ft.

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[1] Engelmann, in *Trans. St. Louis Acad. Sci.* iv. 178 (1886), considered this variety to be a distinct species (*P. Bonapartea*), with stout leaves, showing on section seven resin-canals; while *P. Ayacahuite* has more slender leaves with only two resin-canals. The number of resin-canals, however, is variable, two to eight being found by Shaw in wild specimens; and this character alone cannot be relied on for the discrimination of the type and var. *Veitchii.*

[2] Cf. Loudon, *Gard. Mag.* xv. 129 (1839).

[3] Cf. *Gard. Chron.* xxi. 769 (1884).

[4] Masters, in Lawson, *Pinetum Brit.* loc. cit.

by 6 ft. 8 in. It is pyramidal in habit, with slightly ascending branches. I have raised seedlings from this tree which appeared to me to be hardy, as they endured very severe frosts in early autumn and late spring. Planted, however, on rather heavy soil in a low situation, they succumbed to a frost certainly below zero in the winter of 1908-1909. The tree seems to endure lime in the soil without injury, and may be planted in a dry sunny position in most parts of England.

Another large tree is growing at Beauport, Sussex, and was 55 ft. high and 8 ft. in girth in 1904. At a distance this tree is indistinguishable from *P. excelsa*, having the wide-spreading branches and upturned branchlets which are usual in that species. It bears cones freely, but had increased little in size when seen in 1909.

There is a fine specimen at Bicton, which Mr. H. Clinton-Baker measured in 1908 as 65 ft. by 7 ft. 8 in. At Batsford Park, Gloucestershire, the seat of Lord Redesdale, there are two trees, the larger measuring 42 ft. by 3 ft. The other, more dense in habit and with less spreading branches, is scarcely so tall, and is 2 ft. 10 in. in girth. In Shroner wood, near Winchester, at 450 feet elevation, there is a narrow pyramidal tree, 51 ft. by 3 ft. 8 in., which was bearing ripe cones in February 1910. Mr. E. L. Hillier, who has sent us specimens, stated that this tree was planted in 1889, and is making very rapid growth.

Another in Messrs. Paul and Son's nursery at High Beech, Essex, which was planted probably in 1850-55, is only 30 ft. by 2 ft. 8 in. It survived the severe winter of 1860, which killed a deodar standing beside it; but subsequent hard winters have much damaged the stem on the north side. It bore cones[1] 9 in. long in 1882, and in subsequent years up to 1903, but the seeds proved unfertile when sown.

At Grayswood, Haslemere, trees of this species, growing on light sandy soil, succumbed to the attack of a fungus which affects Weymouth pine in that neighbourhood.

Var. *Veitchii* was introduced in 1857 by Roezl, who gave it many specific names. It is extremely rare in cultivation in England, where, however, it thrives in the mild humid climate of the west and south-west. The largest tree[2] known to us is growing at Heligan, near St. Austell, Cornwall, in the grounds of John Tremayne, Esq., who informed us in 1906 that it was then 60 ft. in height and 8 ft. 6 in. in girth. It measured in 1909, 66 ft. by 9 ft. 8 in. at 3 ft. above the ground, dividing above into several main stems. Another tree,[3] cones of which are preserved in the museum at Kew, is growing at Ballamoar, in the Isle of Man. According to Dr. Tellet, of Ramsey, who sent a specimen branch, it was about 40 ft. high and 4 ft. 8 in. in girth in 1906. At Eastnor Castle a thriving specimen, about 35 feet high, produced cones with apparently fertile seeds in 1908; and the gardener, Mr. Mullins, believes that it was planted about twenty-five years ago. (H. J. E.)

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[1] Figured in *Gard. Chron.* xviii. 492, fig. 83 (1882).

[2] Described and figured as *P. Ayacahuite* in *Gard. Chron.* xx. 748, figs. 131, 132 (1896), when it was said to be 49 ft. high and 7 ft. in girth.

[3] Cf. *Gard. Chron.* vi. 599 (1889), and *Garden*, xxxii. 47 (1887). Dr. Tellet's letter was kindly forwarded to me by the owner, Mrs. Farrant. The soil is sandy—glacial drift containing clay. The tree is supposed to have been planted between 1857 and 1860.

## PINUS LAMBERTIANA, Sugar Pine

*Pinus Lambertiana*, Douglas, in *Trans. Linn. Soc.* xv. 500 (1827); Loudon, *Arb. et Frut. Brit.* iv. 2288 (1838); Lawson, *Pinet. Brit.* i. 47, t. 7 (1884); Masters, in *Gard. Chron.* i. 772, f. 144 (1887), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 578 (1904); Sargent, *Silva N. Amer.* xi. 27, tt. 542, 543 (1897), and *Trees N. Amer.* 5 (1905); Kent, Veitch's *Man. Coniferæ*, 336 (1900); Clinton-Baker, *Illust. Conif.* i. 29 (1909); Shaw, *Pines of Mexico*, 12 (1909).

A tree, attaining in America[1] about 250 ft. in height, and 40 ft. in girth. Bark of young stems and branches smooth, thin, dark green; becoming on old trunks 2 or 3 in. thick and deeply divided into long irregular scaly ridges. Buds cylindrical, rounded at the apex or short-pointed, ¼ in. long, brownish, resinous, with closely, partly glandular appressed scales. Young branchlets smooth, covered with a minute brown, partly glandular pubescence.

Leaves in fives, deciduous in the second and third year, 3½ to 4 in. long, rigid, sharp-pointed, twisted, making a complete turn, serrulate, with two or three stomatic lines on each of the three surfaces; resin-canals marginal; basal sheath ¾ in. long, early deciduous.

Cones sub-terminal, cylindrical, 11 to 21 in. long, 3 to 4 in. in diameter when closed; scales woody, 2 to 2½ in. long, 1½ to 1¾ in. wide, thickened towards the middle line, thin in margin, flat or slightly convex from side to side; apophysis smooth, orange-brown, slightly reflexed at the apex, which is marked with a small thickened resinous umbo. Seed ½ in. or more in length, ovoid, compressed, dark-brown or nearly black; wing 1 to 2 in. long, ½ in. broad, dark-brown, oblique and broadest below the middle. Cotyledons twelve to fifteen.

This species is very variable in the size of the cones, and of the seeds, which often have very long wings.[2] It is readily distinguished from all the other pines of the Strobus section by the rigid leaves, which are sharp-pointed and twisted, the twist making a complete turn.

### Distribution

The sugar pine is the largest species of the genus, and derives its name from the sugar[3] which exudes from wounds that have been made in the heartwood. It is found in Oregon, from the valley of the Santiam river southward along the Cascade and Coast ranges, at elevations of 3000 to 4000 ft.; and extends in California through the Siskiyou and Coast mountains to Napa county,[4] and along the western side of the Sierra Nevada at least 200 miles farther south, where it attains its maximum size at 3000 to 7000 ft. high. It also grows in the southern part of the state in the San Bernardino and Cuyamaca mountains; and was discovered by Brandegee[1] on Mount San Pedro Martir in Lower California. It is seldom found growing pure, occurring usually in open woods in company with *P. ponderosa*, and is most common on mountain slopes and on the sides of ravines and cañons. Douglas fir, *Libocedrus*, *Sequoia gigantea*, and *Abies Lowiana* are also often associated with the sugar pine.

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[1] Dr. W. P. Gibbons, in *Erythea*, i. 161 (1893), says that he has seen a sugar pine 12 ft. in diameter, the height of which was 300 ft.; and another 8 ft. thick, the measurement of which when felled was something over 300 ft.

[2] Sargent, *Trees N. Amer.* 5 (1905), says that the seeds are 1½ to 5 in. long, but this is evidently a misprint for 1½ to 2 in.

[3] This sugar exudation is often found on the surface of the heartwood where a forest fire has scarred the tree. It is white in colour and delicious to the taste, but can only be eaten in small quantity as it is laxative, and bears are said never to touch it. Cf. Muir, in *Harper's Magazine*, xxii. 717.

[4] Jepson, *Flora W. Mid. California*, 20 (1901), says that it forms considerable forests in the high Coast ranges north of Clear Lake, where there are magnificent specimens, 150 to 175 ft. high and 22 ft. in girth. The record in Sonoma County, given in *Erythea*, iv. 152, needs confirmation. Jepson reports it in the Santa Lucia mountains.

This pine is remarkable in its appearance in the forests on account of the long outward and downward sweep of the branches, the first of which often arise at 100 ft. above the ground. Sir Joseph Hooker, who gives a picture of a tree growing near the hotel at Calaveras, not far from the Wellingtonia grove, says[2] that the drooping attitude of the leaves towards the under side of the branches near their tips is very characteristic. The largest tree recorded seems to have been one near the Umpqua river in Oregon found by Douglas,[3] which was 245 ft. in length, as it lay on the ground, girthing at 3 ft. from the ground 57 ft. 9 in., and at 134 ft. up no less than 17 ft. 5 in. Mr. F. R. S. Balfour photographed a fine tree, 27 ft. in girth at 5 ft. from the ground, which was growing near the bend on the M'Cloud river in Shasta County, California. (Plate 271.) Like all travellers, he was much impressed by the size and number of the cones which hung from the ends of the tapering branches. He says that the tree matures at 300 to 400 years old, though trees have been felled with as many as 700 rings. (A. H.)

## CULTIVATION

This noble pine was discovered[3] by Douglas in 1825 on the headwaters of the Multnomah river in Oregon; and was introduced by him in 1827, when plants were raised in the garden of the Horticultural Society at Chiswick, most of which, however, according to Loudon, died before they had attained 5 ft. in height. Lobb[4] collected a further supply of seed in 1851.

Though rather slow in growth, this pine appears to be hardy, and is represented by single specimens in a few collections, more especially in the south of England.

A tree at Dropmore raised from seed given to Lady Grenville by the Duke of Buccleuch in 1843, bore cones for the first time[5] in 1872; and occasionally in subsequent years, thrice in the last eight years. Mr. Page measured it in 1908 as 85 ft. by 10 ft., and says that occasionally the cones are as much as 18 in. in length. There are two younger trees at Dropmore which have not as yet borne cones.

A fine tree at Arley Castle, also raised from the seed sent by Douglas, measured[6] 91 ft. by 10 ft. 8 in. in 1903; and so far as Mr. Woodward can ascertain has never borne cones. There is a well-shaped tree at Eastnor Castle (Plate 272), which occasionally bears cones, 83 ft. by 10 ft. in 1909.

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[1] Cf. *Zoe*, iv. 201 (1893).

[2] In *Gard. Chron.* xxiii. 11, fig. 1 (1885).

[3] *Comp. Bot. Mag.* ii. 92, 130 (1836).

[4] *Hortus Veitchii*, 39 (1906). According to Loudon, *Gard. Mag.* xvii. 429 (1841), Dr. M'Laughlin sent home a parcel of cones in 1841 from Fort Vancouver, on the Columbia river; but it is unknown whether any trees were raised from these.

[5] *Gard. Chron.* 1872, p. 1166.

[6] *Hortus Arleyensis*, 14 (1907).

A splendid tree at Danesbury, near Welwyn, Herts, measured 90 ft. by 10 ft. 4 in. in 1907, and produced cones for the first time in 1897. There are several other good specimens in the same county; two trees at Brickendon Grange, the larger of which was 49 ft. by 4 ft. 10 in. in 1906, when it bore cones; another at Bayfordbury which measured 64 ft by 7 ft. 3 in. in 1905, and has borne cones of late years.

At Nuneham Park, Oxford, a fine tree measured 75 ft. high and 10 ft. 9 in. in girth in 1906. Mr. H. Clinton-Baker in 1907 saw a tree at Flitwick Manor, Bedford, 72 ft. by 7 ft. 6 in., which was bearing numerous young cones.

Sir Hugh Beevor reports a tree at Fulmodestone, Norfolk, said to have been planted about 1851, which was 60 ft. by 6 ft. 5 in. in 1903. A tree[1] at Barton, Suffolk, measured 65 ft. by 10 ft. in 1905.

The best specimen in Kew Gardens measured 63 ft. by 4 ft. 7 in. in 1903.

A fine tree, measuring 74 ft. by 7½ ft. in 1908 when it produced cones, grows in the grounds of Bowood Park, Wilts, the seat of the Marquess of Lansdowne. It is said to have been planted about the year 1838.

The following were the only trees of the species mentioned in the reports[2] sent to the Conifer Conference in 1891:—Revesby Abbey, Lincolnshire, forty-three years old, 50 ft. high, 6 ft. 8 in. in girth; Poltalloch, Argyllshire, 45 ft. high, 9 ft. in girth, said to be growing vigorously.

Murray reported[3] in 1860 that a fine tree, now no longer living, in the Keillour Pinetum, had produced cones for several years past. This is remarkable, if true, as this species, rare in Scotland, appears to bear fruit only in the south of England.

In Ireland it is not common, the best I know of being a tree at Woodstock, which in 1909 was 62 ft. by 6 ft.

A tree in the Wellesley Pinetum,[4] Massachusetts, U.S.A., was 27 ft. high in 1905; but Sargent says that although hardy as far north as Boston, it is not worth growing in New England except as a curiosity. (H. J. E.)

## PINUS MONTICOLA, Western White Pine

*Pinus monticola*, Don, in Lambert, *Genus Pinus*, ii. t. 81 (1832), and iii. t. 87 (1837); Loudon, *Arb. et Frut. Brit.* iv. 2291 (1838); Sargent, *Silva N. Amer.* xi. 23, tt. 540, 541 (1897), and *Trees N. Amer.* 5 (1905); Kent, Veitch's *Man. Coniferæ*, 349 (1900); Masters, *Journ. Linn. Soc.* (*Bot.*) xxxv. 580 (1904); Clinton-Baker, *Illust. Conif.* i. 36 (1909).

*Pinus Strobus*, Linnæus, var. *monticola*, Nuttall, *Sylva*, iii. 118 (1849).

*Pinus porphyrocarpa*, Murray, in Lawson, *Pinetum Brit.* i. 83, ff. 1-8 (1884).

*Pinus Grozelieri*, Carrière in *Rev. Hort.* 1869, p. 126, f. 31.

A tree, usually attaining in America 100 ft. in height and 15 ft. in girth, rarely as high as 150 ft., with a trunk 25 ft. in girth. Bark of young stems and branches thin, smooth, and light grey, becoming on old trees 1½ in. in thickness and divided by fissures into small square scaly plates. Buds, as in *P. Strobus*, but larger. Branchlets, covered with short, brown, partly glandular[1] pubescence, retained in part in the second year.

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[1] There is no record of this tree in Bunbury, *Arboretum Notes*.

[2] *Journ. Roy. Hort. Soc.* xiv. 492, 503 (1892). A tree at Keir, Perthshire, incorrectly reported (*ibid.* 531) to be *P. Lambertiana*, turns out to be *P. Strobus*.

[3] In *Trans. Bot. Soc. Edin.* vi. 370 (1860).

[4] Sargent, *Pin. Wellesley*, 10 (1905).

Leaves, in fives, slightly spreading, dense upon the branchlets, persistent for three or four years, about 4 in. long, often only 2 to 3 in. long in native specimens, rigid, broader and thicker than in *P. Strobus*, serrulate, narrowed but blunt at the apex, with several stomatic lines on the inner surfaces, and two to three broken lines of stomata on the outer surface near the tip; resin-canals marginal; basal sheath about ¾ in. long, early deciduous.

Cones spreading, on short stout incurved stalks, cylindrical; very variable in length in wild specimens, averaging 5 to 8 in., occasionally 12 and rarely 18 in.; in cultivated specimens usually about 5 in. Scales thin, oblong-cuneate, averaging 1½ in. long and ¾ in. broad; apophysis rounded and thin in upper margin, slightly convex from side to side, and tipped with a small dark-coloured resinous umbo. Seed narrowed at the end, ⅓ in. long, reddish brown, mottled with black; wing about 1 in. long, narrow, pointed, dark brown. Cotyledons 6 to 9.

The cones are usually green in colour before ripening, but a tree at Glenalmond in Scotland produced purple cones and has been named var. *porphyrocarpa*, Masters.[2] (A. H.)

### DISTRIBUTION

This tree represents *P. Strobus* in the Pacific coast region of North America, where it occurs in the north in Vancouver Island, in the Columbia river valley, and on the Selkirk range in British Columbia; and extends southwards to Idaho, where it attains its maximum size in the Bitter Root Mountains, and to the western slopes of the Rocky Mountains in northern Montana; and is found throughout the coast ranges of Washington and Oregon, and on the Cascade and Sierra Nevada ranges as far as the Kern river valley in California. It descends[3] to sea-level in Vancouver Island, ascends in the Selkirks to 2500 ft., and reaches 10,000 ft. altitude in the Californian Sierras, where trees with enormous stems and short twisted branches withstand for centuries the fiercest mountain gales.[4]

It does not often grow as pure forest, but wherever I have seen it, is mixed with other conifers, and most abundant in regions where there is a heavy rainfall, though usually not a large tree in comparison with others in the same region, and commonly about 100 ft. high. Sargent gives 150 as its extreme height, and Sheldon says 100 to 200 ft. I measured at 1650 ft. elevation near Camp 6 of the Victoria Lumber Company at Chemainus in Vancouver Island, a tree which was at least 200 ft. high by 13½ ft. in girth, with a stem clear of branches to 80 or 90 ft. It is not abundant here, and though occasionally cut up in the sawmills, does not form an important item in the timber resources of British Columbia.

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[1] Some of the hairs are tipped with a globose gland.

[2] In *Journ. R. Hort. Soc.* xiv. 235 (1892). This is *P. porphyrocarpa*, Murray, in Lawson, *Pin. Brit.* i. 83 (1884).

[3] Throughout the greater part of its range, it occurs at considerable altitudes, and though in south-western Vancouver Island it grows sparingly through the coast forest, it is more abundant at 500 ft. where the fogs are less and the summer days are warmer. Close to the sea, trees are usually somewhat stunted. Cf. Butters, in *Postelsia, Year Book of the Minnesota Seaside Station*, 1906, p. 160.

[4] *Garden and Forest*, x. 460 (1897). In this journal, v. 1, figs. 1 and 2 (1892), there are two excellent illustrations of trees of great age, growing in an exposed situation in the Yosemite valley.

According to Macoun and Anderson[1] the wood is used for the same purposes as eastern white pine. It is useful for window-sashes, doors, powder barrels, and similar work, but being a white and very light wood it is unfit for outside work and decays rapidly in contact with the ground.

In north-western Montana, this species does not ascend above 4000 ft. and never crosses the continental divide. It is of rather rare occurrence in the Flathead region where scattered trees grow in the mixed forest, which is mainly composed of western larch and Douglas fir. It thrives best on moist soil, but on swampy ground has shallow roots and is often blown down. Seedlings[2] germinate in the open, where the soil is not too dry; but they bear a certain amount of shade, though they are never seen under the dense cover of *Thuya plicata* or *Tsuga Albertiana*.

## CULTIVATION

Though discovered by David Douglas in 1831 and introduced by him soon afterwards, the tree did not become common in England until Lobb and others sent seeds in quantity between 1851 and 1855. It seems to be perfectly hardy as regards cold everywhere, but does not succeed as well in England generally as in Scotland, and even there it seems very subject to the attacks of a rust which was identified by Mr. W. G. Smith as *Peridermium pini*,[3] and which is described by Mr. J. Laurie, gardener at Murthly Castle, as spreading over all the trees there, but not attacking *P. Strobus* which grows close by. From what I have seen elsewhere this or a similar rust has destroyed other trees in different parts of the country. It seems to succeed best in the wetter parts of Scotland, and to dislike lime, as the seedlings I have raised will not grow at Colesborne. It cannot be recommended on our present knowledge as a forest tree in this country.

Among the finest I have measured in England are those at Adhurst St. Mary near Petersfield, the seat of Miss Bonham Carter, where in 1908 I measured a tree growing on the lower greensand which was 78 ft. by 5½ ft. At Barton, in 1904, a tree with three leaders was 79 ft. by 8 ft. It was planted in 1848[4] and bore cones in 1864. At Beauport, two trees, 81 ft. by 7 ft. and 68 ft. by 7½ ft., were healthy and covered with cones in 1905. At Enville Hall, Staffordshire, Henry saw a beautiful glaucous tree which in 1904 was 77 ft. by 6 ft. At Kew, a tree on the lawn north-west of the Water Lily house, planted in 1843, measured in 1903, 63 ft. by 5 ft. 1 in.[5] At Highnam, Major Gambier Parry in 1906 measured a tree 64 ft.

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[1] *Brit. Columbia, Bureau Inform., Bull. No.* 15, p. 239 (1903).

[2] Cf. Whitford, in *Bot. Gas.* xxxix. 201 (1905). Henry in 1906 saw numerous seedlings near Nyack on the Great Northern railway. The tree is of no economic importance in Montana, and is estimated by Ayres to yield about one per cent of the total timber in the Lewis and Clarke Forest Reserve. Elrod gives 10 ft. as the maximum girth.

[3] *Gard. Chron.* xxiii. 244 (1898). Smith says that the rust is *Peridermium pini* and not *P. Strobi.* The two fungi are distinct. Cf. Smith, *ibid.* 202. According to Ulmer, in *Naturw. Zeitsch. forst. Landwirtschaft*, 1908, pt. 12, of all the five-leaved pines in the forest garden at Tharandt in Saxony, only *P. monticola*, of which there are several trees eighteen years old, is attacked by *Peridermium Strobi.* Experiments in that place have shown that the only species of *Ribes* infected by the spores is *R. sanguineum.*

[4] Bunbury, *Arboretum Notes*, 133 (1889).

[5] *Kew Hand-List Coniferæ*, xiv, xxii (1903).

by 6 ft. 8 in. At High Leigh, Hoddesdon, Mr. Clinton-Baker in 1908 measured a tree 66 ft. by 4 ft. 10 in.

In Scotland the largest known to us is a tree at Murthly (Plate 273), which, when I saw it in 1906, was 85 ft. by 6½ ft. and covered at the top with cones. The next is at Scone, in Perthshire, the seat of the Earl of Mansfield. This, when measured in 1891 for the Conifer Conference, was 71½ ft. high, by 5 ft. 11 in. in girth at about forty years of age; and when measured by Henry in 1904 had increased to 82 ft. by 7 ft. 9 in., and was quite healthy. Another at Keillour, which is probably one of Douglas's original introduction, as it was planted in 1834, was in 1904 80 ft. by 6 ft. 9 in.; and there are many others in Scotland which are from 60 ft. to 70 ft. high. One at Monreith, Wigtownshire, planted in 1876, measured in 1908 56 ft. by 4 ft. 11 in., whilst *P. Cembra*, planted with it at the same time, is only 16 ft. high. Another at Poltalloch, raised from the seed of a tree at Lamb Abbey, measured 50 ft. by 5¼ ft. in 1906, and has itself produced fertile seed.

In Ireland it also grows well. At Hamwood, Co. Meath, the seat of C. R. Hamilton, Esq., there is a splendid tree planted in 1847 which Henry measured in 1904 and found to be 76 ft. by 7 ft. At Fota, another measured 69 ft. by 6 ft. 8 in. in 1907. (H. J. E.)

## PINUS STROBUS, WEYMOUTH PINE, WHITE PINE

*Pinus Strobus*, Linnæus, *Sp. Pl.* 1001 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2280 (1838); Sargent, *Silva N. Amer.* xi. 17, tt. 538, 539 (1897), and *Trees N. Amer.* 4 (1905); Kent, Veitch's *Man. Coniferæ*, 377 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*), xxxv. 579 (1904); Clinton-Baker, *Illust. Conif.* i. 52 (1909).

*Pinus tenuifolia*, Salisbury, *Prod.* 399 (1796).

*Pinus alba canadensis*, Provancher, *Fl. Canadienne*, ii. 554 (1862).

A tree, attaining in America at the present time 150 to 175 ft. in height and 10 to 15 ft. in girth, but stated to have been much larger formerly. Bark on young stems, thin, smooth, and greenish; on old trunks 1 to 3 in. in thickness, and divided by shallow fissures into broad connected scaly ridges. Buds ovoid, sharp-pointed, ¼ in. long, brown, resinous, with some of the scales free at the tips. Young branchlets with short tufts of pubescence below the insertions of the leaf-clusters on the slightly raised pulvini, being glabrous elsewhere.[1]

Leaves in fives, persistent two or three years, spreading, 3 to 4 in. long, very slender, straight, serrulate, whitened with stomatic lines on the two inner surfaces; resin-canals marginal; basal sheath ⅝ in. long, early deciduous.

Cones sub-terminal, pendulous on stalks (usually less than 1 in. long), cylindrical, often curved, pointed at the apex, 4 to 6 in. long, 1 in. in diameter. Scales 1 to 1¼ in. long, ½ to ⅝ in. wide, usually very convex from side to side; apophysis smooth, rounded, and thin in upper margin, slightly thickened in the centre, terminating in a small resinous flat umbo. Seed ovoid, ¼ in. long, reddish brown, mottled with black; wing narrow, 1 in. long. Cotyledons 7 to 14.

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[1] Occasionally the pubescence is diffused over the whole surface of the branchlet, but remains densest on the pulvini.

### VARIETIES

Several forms with variously coloured foliage or of peculiar habit have arisen in European nurseries.[1]

1. Var. *nana*, Knight, *Syn. Conif.* 34 (1850). A compact round-headed shrub rarely exceeding 6 ft. in height, with short slender branches, and crowded branchlets; leaves short, ¾ to 1½ in. in length. A specimen of this variety planted at Bayfordbury in 1849 is about 15 ft. high. Sargent says that this is perhaps one of the most distinct and beautiful of all the dwarf conifers in cultivation; and those which Elwes saw at Underley Hall, Westmoreland, the seat of Lord H. Cavendish-Bentinck, confirmed this opinion.

2. Var. *nivea*, Booth, *ex* Knight, *loc. cit.* Leaves short, and silvery white beneath.

3. Var. *aurea*. Leaves yellowish when young.

4. Var. *variegata*. Leaves variegated with yellow.

5. Var. *zebrina*. Leaves striped with yellow.

6. Var. *monophylla*, Tubeuf, *Forst. naturw. Zeitschr.* vii. 34 (1897). A variety with the needles more or less cohering throughout their length, and forming a single needle.

7. Beissner also mentions fastigiate and prostrate varieties, which do not seem to be in cultivation in England.

### DISTRIBUTION

*P. Strobus* is the largest of all the conifers indigenous in North America eastward of the Rocky Mountains; and its original area of distribution comprises a vast territory in Canada and the northern United States, roughly bounded on the north by the parallel of 50° from south-eastern Manitoba to Newfoundland, and on the south by the parallel of 42° from Iowa to Connecticut; while it spreads southwards in the Alleghany mountain region from Pennsylvania and New Jersey, through Maryland, West Virginia, Virginia, Kentucky, North and South Carolina, Tennessee, to the northern parts of Alabama and Georgia, becoming rarer and confined to high altitudes towards the south. It grows up to about 3500 ft. on the Blue Ridge, but does not there attain anything like the size it does farther north, 60 to 70 ft. high being about the size of the trees which Elwes saw in North Carolina.

Although still met with throughout this vast region, the original forest has in many parts been cut away, and in some districts, as in New England and eastern Canada, the species only remains in small areas. The great forests, where the pine occurs in commercial quantity, are now confined to Michigan, Minnesota, and Wisconsin in the United States, and to the Ottawa valley, and to the districts bordering Lake Huron and Lake Michigan in Canada.

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[1] Sargent, in *Garden and Forest*, x. 460 (1897), mentions two varieties of American origin growing in the Arnold Arboretum; one, dwarf with pendulous, nearly prostrate branches; the other, with short, slender, nearly erect branches, in whorls of three, growing a dense, low, round-topped head.

The white pine is less gregarious than many other pines, and originally formed an important component of the mixed deciduous forest of New England, New York, and Pennsylvania, attaining its best development along water-courses, and reaching its greatest size when growing in mixture with beech, maples, and birches, often towering in such woods high above the general level of the other trees. It is often, however, in the same regions associated with hemlock; and in eastern Canada is frequent in company with hemlock, spruce, and *Thuya occidentalis*.

The pine forests, which cover large tracts of sandy soil in the Lake States, are composed of varying mixtures of *P. Strobus*, *P. resinosa*, and *P. Banksiana*.[1] On poor dry sand the two latter species outgrow and supplant the former, while on moist deep sand *P. Strobus* is the more vigorous. Its growth is much aided by the presence of organic matter and loam in the sand, and on soil of this kind, pure woods of white pine, sometimes several square miles in extent, occur. With an increase of loam in the soil, deciduous trees make their appearance, and the forest becomes a varied mixture of these trees and *P. Strobus*. On heavy clay soil, the white pine tends to disappear, and a forest of only hardwoods results.

On sandy soil in the eastern states, *P. rigida* is the companion of the white pine, and in the southern states, *P. echinata*.

This tree prefers a climate with considerable moisture in the air, as is shown by its abundance in the region of the Great Lakes and towards the seaboard. It withstands windy and cold exposures, but suffers from strong sea-breezes. It excels all pines in its capacity for bearing shade in the early stage of its growth, and reproduces itself naturally under oak, but not under beech or maples. It is long in cleaning its stem, even where the young growth, as is often the case, forms dense thickets. (A. H.)

Though it is improbable that any such trees now exist, Sargent quotes various old writers to show that in former times trees rivalling the giant pines of California were found in New England. A tree, 7 ft. 8 in. in diameter at the butt, on the Merrimac river; and another, 6 ft. in diameter and 260 ft. high, in Lincoln,[2] N.H., are mentioned as instances. But trees of 150 ft. high, 24 in. in diameter, are now quite uncommon, and the largest actually measured in Pennsylvania by Pinchot was 155 ft. high, 3½ ft. in diameter at 4½ ft. from the ground, and 357 years old.

Emerson tells us[3] that fifty years ago several trees at Blanford, which grew

[1] In the Cass Lake Forest Reserve, in Minnesota, which I visited in 1906, these three pines occur; and *P. Strobus* invariably occupied the better soil where the sand contained a percentage of blackish mould.

[2] With regard to the gigantic heights given by early writers I am very sceptical, and Prof. W. A. Buckhout, of the Pennsylvania State College, to whom I wrote for information, shares my doubts. The most authoritative statement is by Fox, in *U.S. Forestry Bull.* No. 34, p. 8 (1902), who says: "there is a record of a white pine cut in Meredith, Delaware County, New York, that measured 247 ft. in length as it lay on the ground." He adds: "Many New York lumbermen still living recall giant white pines 7 ft. or more across the stump, and over 220 ft. in height." Fox does not state where the record exists or its authority; and Springer, in *Forest Life and Forest Trees*, 40 (New York, 1851), says: "In Dr. Dwight's *Travels*, there is an account of a tree in Lancaster, New Hampshire, which measured 264 ft. in length. I have worked in the forests among the timber several years, have cut many hundreds of trees and seen many thousands, but have never found one larger than the one I felled on a little stream which emptied into Jackson Lake in the eastern part of Maine. Its trunk was 6 ft. in diameter at 4 ft. from the ground. It was about 9 rods in length or 144 ft., about 65 ft. of which were free of limbs, and retained its diameter remarkably well." The tree mentioned in *Garden and Forest*, 1894, p. 188, which grew in Wisconsin, and was said to be 200 ft. high and 45 in. in diameter, is also exaggerated, I believe, as regards its height.—(A. H.)

[3] *Woody Plants Massachusetts*, i. 74 (1875).

on rather dry land, measured after they were felled over 223 ft., and speaks of a mast cut on the Penobscot river in 1841, which, after being hewn to an octagonal shape, measured 90 ft. long, 36 in. in diameter at the butt, and 28 in. at the top.

The tree lives to a very great age, remaining sound up to 350 or 400 years, and it is said in New England that no one has lived long enough to see the stump of a white pine decay. Fences made from the stumps after they have been torn up by the roots, show after 100 years few signs of decay.

The white pine grows naturally on all kinds of soil, and varies very much in its habit according to the soil and surroundings, but flourishes best in a deep, moist sandy loam, and in land which, being covered with a thick growth of moss, never dries in summer.

The trees now commonly seen by the traveller in New England, which have been left when the original forest was felled, or which have sprung up from seed on abandoned farms, or as second growth in forest which has been logged, give no idea of what the tree is in a virgin forest. These are now only found in remote localities from which the logs cannot be profitably extracted; and the ingenuity of the lumberman is so great, and the present value of large clean logs so high, that it is not easy to find any which have not been cleared of their finest timber.

The reproductive power of the tree is very good, whenever fire is kept out of the forest, and large areas of land which have been abandoned by the descendants of the original settlers as unprofitable to cultivate, are now becoming[1] re-covered with white pine, from which second growth in New Hampshire and Vermont alone, Sargent tells us that no less than 100,000,000 ft. of lumber were manufactured in the year 1880.

A remarkable instance of the rapid growth and branching habit of the white pine on land which has been burnt over is described by Mary Robbins in *Garden and Forest*, viii. p. 333. These trees are in a large cemetery at St. Stephen, New Brunswick, on land which was devastated by fire in 1821. The largest of them in 1895 were 75 ft. high and 11 ft. or more in girth, with high horizontal or perpendicular branches coming off close to the ground, some of which are as much as 7 ft. in circumference and spread 40 to 60 ft. from the trunk.

## HISTORY AND CULTIVATION

The white pine was first described by Plukenet[2] in 1696, and according to Aiton[3] was first cultivated[4] at Badminton in Gloucestershire by the Duchess of Beaufort in 1705. Its common English name was given it because Lord Weymouth planted it[5] largely in the beginning of the 18th century at Longleat, Wilts;

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[1] In *U.S. Forest Service, Circular* 67 (1907), a leaflet on the planting of this species, it is said that in many situations, if the land is protected from fire, white pine will extend itself rapidly by natural seeding; and planting is recommended only when natural regeneration is impracticable.

[2] Plukenet, *Amalth. Bot.* 171 (1705).

[3] *Hort. Kew.* iii. 369 (1789).

[4] It was introduced earlier into France, as a plant was growing in the Royal Nurseries at Fontainebleau in 1553. Cf. Belon, *De Arboribus Coniferis*, published in that year, and quoted by Bolle, in *Gartenflora*, 1890, p. 434.

[5] The date of first planting at Longleat is uncertain, and possibly preceded that at Badminton. In *London Catalogue of Trees by Society of Gardeners*, 57 (1730), it is said that "Lord Weymouth's pine was raised from seed in Badminton Gardens several years since, and has been growing many years in the gardens of Lord Weymouth, where it hath produced ripe seed for several years."

and Miller says that at Mersham le Hatch, near Ashford, Kent, then the property of Sir Wyndham Knatchbull, and still held by his descendant of the same name, it produced, as early as 1726, good seed from which many of the trees in England were raised. I have been unable to find any trees either at Badminton or at Longleat which can be certainly looked on as the original trees;[1] but there are many places in England where trees dating from at least the middle of the 18th century still survive, and some of these, as will be shown later, are of great size.

The tree is apparently at home on all good deep sandy soils, and when not too dry, grows vigorously for 100 years or more in all the southern half of England; ripening seed in most seasons and often reproducing itself naturally; but in Scotland it does not seem to thrive so well, probably on account of insufficient heat in summer. I do not, however, think that it is likely in any part of Great Britain to prove a profitable forest tree in comparison with Scots or Corsican pine, as the value of its timber depends on climatic and soil conditions rarely found in this country.

The Weymouth pine has been extensively planted in Germany, there being, for example, 3,000,000 trees in the state forests of Bavaria. In central Europe, it is remarkably hardy, as it is not injured by the severe winter climate, never suffers from spring or autumn frosts, and is not easily broken by heavy snow. It is considered, on account of the abundant fall of its soft needles, which speedily decay, to be a better soil-improver than any European pine. Slow in growth during the first five years, it attains about the same height as the Scots pine in the twentieth year, and exceeds the latter species considerably in height and diameter growth after this period. Dr. L. Wappes,[2] a Bavarian forester, states that it seeds early and heavily, is readily reproduced naturally,[3] withstands crowding and shading, and produces even on poor soils a large amount of timber. On very inferior soil in the Palatinate, pure plantations, 104 years old, yielded per acre, 13,000 cubic ft. of timber, exclusive of branches and stumps. In spite of such results, much exceeded on loamy sands at other stations in Prussia and Thuringia, it is doubtful if this tree will be planted extensively in the future. It is much subject to the attacks of fungi, many plantations being ruined by *Agaricus melleus* and *Peridermium Strobi*, while deer bite the shoots and gnaw the bark, injuring many trees in the German forests.

The timber produced in central Europe appears to be as good as that of America, and Wappes states that though little valued at first, it is now readily saleable, the price in 1899 being double that of 1882. Mayr[4] gives an instructive comparison of the wood of two trees, one 87 years old, grown in Bavaria; the other, 138 years old, grown in Wisconsin. The specific gravity of both was identical; and the Bavarian tree excelled in having a less proportion of sapwood. These two trees contained nearly the same percentage of resin; and Mayr's researches have shown that the wood of the Weymouth pine contains more resin than that of Scots pine, larch, spruce, or silver fir. He considers that its qualities of lightness and softness, for which it is esteemed in America, render it useful for many purposes, for which it is better fitted than any European species.

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[1] Forbes, in *Pin. Woburn.* 83 (1839), says: "The original tree, first brought to England by Viscount Weymouth, is now standing, though perfectly decayed, in a timber grove at Longleat." According to *Museum Rusticanum*, iv. 381 (1765), gold and silver medals were offered by the Society for the Encouragement of Arts, in 1765 and succeeding years, for plantations of Weymouth Pine. According to Dillwyn, *Hortus Collinsonianus*, 40 (1843), Bartram sent a small tree to Collinson in 1737, which was growing at Mill Hill in 1756, when it was 40 ft. high.

[2] The articles on the cultivation of this pine in Germany, which Dr. Wappes published in Lorey's *Allgemeine Forst- und Jagdzeitung* for 1899, are abstracted by Spalding, in *U.S. Forestry Bulletin*, No. 22, *The White Pine*, p. 68 (1899).

[3] Unwin, *Future Forest Trees*, 90, fig. 1 (1905), gives a good picture of natural reproduction of the Weymouth pine in the Rhine Palatinate.

[4] *Fremdländ. Wald- und Parkbäume*, 378 (1906). Mayr's article on "White Pine in Europe," published in *Garden and Forest*, 1888, p. 10, should also be consulted.

In Belgium the finest specimens of the Weymouth pine are a group of seven trees standing close together in good soil beside a pond on the farm of St. Michel, in the western Ardennes, not far from St. Hubert. These are growing at an altitude of 1000 ft., and the largest measured in 1909, when they were seen and photographed by Henry, 110 ft. high and 8 ft. 8 in. in girth. They have produced seed freely from an early period, and there are many seedlings of different ages in the vicinity, some, believed to have been of this source, being as far away as two miles to the westward. The dry easterly winds open the cones, and distribute the seeds to a great distance. To the eastward of the tree the seedlings, though numerous, only extend about 200 yards. The older trees are not attacked by the "rouge" (*Peridermium Strobi*[1]), but many of the younger trees are affected. This pine succeeds well at considerable elevations in the Ardennes, and would be a desirable acquisition were it not for its liability to disease.

This tree grows well as far north as Christiania, where I have seen in the grounds of Baron Wedel Jarlsberg at Bogstad a healthy specimen about 90 ft. high, with a clean trunk of about 12 ft. in girth. According to Schübeler, it has been planted at many places on the coast as far north as Trondhjem, and in Sweden as far as 64° N.

On the Isola Bella, in Lago Maggiore, I saw in 1906 a fine tree, 98 ft. by 10½ ft. and covered with cones, which is said to have been brought from Paris in 1815.

### REMARKABLE TREES

By far the largest tree of which we have an exact record, grew in a sheltered valley at Ironmill Wood not far from Tortworth, Gloucestershire, and, as I learn from the Earl of Ducie, was measured[2] in 1864 by Sir Joseph Hooker and Professor Balfour, who made it about 114 ft. high by 10½ ft. in girth. It was blown down in 1875 when it was believed to be about 105 years old, and measured 122 ft. high and 46 ft. to the first branch, containing no less than 324 cubic feet of good timber, which was cut up and used on the estate.

The next largest is a tree at Stowe, probably at least 150 years old, which in 1905 when I measured it, was 104 ft. high by 13 ft. 2 in. in girth at 3 ft., where the stem divides into several massive ascending limbs.

At Pains Hill, Surrey, there is a remarkable old tree with very spreading branches, not mentioned by Loudon, which in 1904 was about 90 ft. high by 12 ft. 8 in. in girth.

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[1] This fungus was first noticed in England, in 1892, at King's Lynn. Cf. Plowright, in *Gard. Chron.* xii. 133, figs. 22, 23 (1892); xiii. 425 (1893); xxvi. 72, 94 (1899). Dr. Somerville, in *Quart. Journ. Forestry*, iii. 232 (1909), gives an account of its ravages in late years.

[2] In *Gard. Chron.* 1853, p. 725, this pine was reported to have been planted in 1772; and it measured in 1853, 114 ft. by 9 ft. 10 in.

At The Grove, Herts, there are two large rough and branching old trees, one of which Henry in 1904 found to be 96 ft. by 12 ft. 2 in. Another at Cassiobury Park measured 102 ft. by 8½ ft. in the same year.

In the Belvedere plantation, Windsor, there are a number of fine Weymouth and Scots pines planted about 1760, according to Menzies, though Mr. Simmonds, who showed them to me, thought that they may be older. The best of the former measure about 100 ft. by 9 ft., are clean for half their length, and are little if anything less in size than the Scots pine presumably of the same age.

At Hollycombe, Sussex, the seat of J. C. Hawkshaw, Esq., there are some of the cleanest and best grown trees of their age in England growing among larch near the entrance to the lodge. The best I measured was over 100 ft. high by 8½ ft. in girth, and contained 120 to 150 ft. of timber. Mr. Hawkshaw informs me that these trees are about 100 years old.

At Woburn Abbey this tree has been planted to some extent on sandy soil, which suits Scots pine very well, but which is apparently too dry for *P. Strobus.* On the Green Drive there are some large old trees left, of which the best measured in 1908 about 90 ft. by 7½ ft., but the majority have died or been felled; and the self-sown seedlings which are numerous in the plantation are mostly suffering from the attacks of a species of Chermes.[1]

At Arley Castle there is a tree 95 ft. by 11 ft. 4 in. in 1905, which is perhaps not over 80 years old. At Ombersleigh Court, the seat of Lord Sandys, a tree, with large branches forking low down, in 1906 was 90 ft. by 16½ ft. near the ground.

At Nuneham Park, Oxford, a tree with a clean stem, was 95 ft. by 7 ft. 9 in. in 1908. At Burwood House, near Cobham, Surrey, Mr. R. Woodward in 1903 measured a tree 92 ft. by 8 ft. 3 in. A tree in a field near Coombe Bank, Sevenoaks, was 80 ft. by 9 ft. 8 in. in 1904.

At Black Park, near Slough, the property of Sir R. Harvey, Bart., in a dense wood of Scots pine near the upper end of the lake, there is a very fine Weymouth pine growing on moist sandy soil, which, when I measured it in 1908, was about 110 ft. high by 9 ft. in girth; the stem forking at 58 ft. from the ground contains about 200 ft. of timber.

At Gwydyr Castle, N. Wales, the property of Earl Carrington, there are several large clean trees growing in a wood, with stems clean to a considerable height, which I saw in 1906 and found to be from 100 to 110 ft. high and 9 to 10 ft. in girth.

The largest in Scotland of which I have certain knowledge is one of nine trees on the banks of the Almond, at Logiealmond, the property of the Earl of Mansfield. Mr. A. Kinnear has recently measured these, and informs me that the largest is 94 ft. high and 7 ft. 9 in. in girth, with a cubic content of 119 ft. over bark. The remaining eight are from 60 to 80 ft. high, growing on a steep bank of light, dry soil, facing west.

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[1] Gillanders, *Forest Entomology*, 331, 336, fig. 307 (1908), says that *Chermes corticalis*, Kalt., is common in the south of England, and is said to do great injury to the trees. The stems attacked resemble in appearance those of beech trees, affected by *Cryptococcus Fagi*; but the two insects have no connection whatever, although on one occasion the absurd proposal was made to cut down Weymouth pines to prevent the extension of the beech disease on a certain property. This aphis is also harmful to the Weymouth pine in Germany.

Sir Herbert Maxwell reports[1] a very large tree at Dunkeld, 13 ft. 3 in. in girth. At Keir, Perthshire, there is a tree 59 ft. by 6 ft. 11 in., which was reported[2] at the Conifer Conference in 1891 to be 40 years old, and 46 ft. by 6 ft.

In Ireland, there are two fine old trees, both about 80 ft. by 7½ ft., at Woodstock; and a tree at Muckross, Kerry, was in 1908 about 65 ft. high, and 8 ft. in girth. Another at Coolattin, Wicklow, was 73 ft. by 7 ft. 7 in. in 1906; but the forester here reported that larger trees were to be found on this property, where this species thrives, and produces valuable timber.

## Timber

The wood of the white pine is, in Sargent's words,[3] "light, soft, not strong, close, straight-grained, very resinous, easily worked, light brown, often tinged with red, with thin, nearly white sapwood, weighing only 24 pounds to the cubic foot when quite dry."

For a century or more it has played a conspicuous part in the material development of the United States and Canada. "Great fleets of ships and long railroads have been built to transport the lumber sawn from its mighty trunks, men have grown rich by destroying it, building cities to supply the needs of their traffic, and seeing them languish as the forests disappear." Fifty years ago the supply seemed inexhaustible, and for a long period the price of white pine lumber governed that of most other woods, whilst it formed a basis of comparison for the quality of other kinds of trees.

Now the best sources of supply are so much depleted that though, in Michaux's time, three-quarters of the houses, except in the great cities, were built mainly of white pine, it has become so scarce and risen so much in price that Canadian forests are largely purchased by American lumbermen to supply their own needs, and the export to Europe has very much diminished.

Much of what still comes is moreover cut from smaller and younger trees, often of second growth, and is inferior in quality to that which gave its reputation, and which was preferred to all others on account of the facility with which it worked up for all domestic purposes.[4]

Laslett, as timber inspector to the British navy at a time when ships were still built of wood, gives numerous details[5] of the experiments which were made on its strength, elasticity, and durability, and states that it was used for masts, yards, bowsprits, and in the form of deals, but says it was not strong enough for light spars subject to great and sudden strains, for which it was inferior in strength and durability to Oregon fir.

Mr. Weale of Liverpool writes to me as follows:—"It is the most generally useful of all the pines, and is largely exported to Europe. As a building timber it is durable for such purposes as windows and doors, but deteriorates if exposed to alternate heat and damp. It is in favour for the inside linings of furniture, but for this purpose is rapidly giving place to the American whitewood, *Liriodendron tulipifera*, the latter having a lower price to recommend it. For pattern-making, the yellow pine[1] is preferred to all other woods, being soft, easily worked, straight-grained, and of a mellow texture. Its value has been steadily advancing for some years, the fine trees producing the best timber becoming scarce in the more accessible districts, and a great and growing demand from the United States, being the chief reasons. The first quality wood in 1905 was 20 per cent greater in price than ten years previous. It is generally imported into Europe in the form of sawn deals, and the disposal in England is practically in the hands of two firms." (H. J. E.)

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[1] *Memories of the Months*, 3rd series.

[2] Erroneously named *P. Lambertiana*, in *Journ. Roy. Hort. Soc.* xiv. 531 (1892).

[3] *Silva*, xi. 19 (1897).

[4] *Popular Science Monthly*, xxviii. 682.

[5] *Timber and Timber Trees*, 356-66 (1894).

## PINUS PARVIFLORA, Japanese White Pine

*Pinus parviflora*, Siebold et Zuccarini, *Fl. Jap.* ii. 27, t. 115 (1844); Syme, in *Gard. Chron.* x. 624, f. 103 (1878); Engelmann, *Revision Genus Pinus*, 178 (1880); Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 504 (1881), and xxxv. 578 (1904); Mayr, *Abiet. jap. Reiches*, 76, t. v. f. 19 (1890), and *Fremdländ. Park- u. Waldbäume*, 386 (1906); Kent, Veitch's *Man. Coniferæ*, 353 (1900); Clinton-Baker, *Illust. Conif.* i. 40 (1909).

A tree attaining in Japan in favourable situations 100 ft. in height, but usually smaller. Bark smooth and greyish for many years, ultimately becoming on old trunks darker in colour and fissuring into small scales. Buds ovoid, less than ¼ in. long, not acuminate at the apex, light brown, slightly resinous, with some of the scales free at the tips. Young branchlets smooth, greyish, with a scattered minute pubescence.

Leaves in fives, persistent for three years, spreading, about 2 in. long, curved, usually blunt at the apex, serrulate, with the inner flat surfaces marked by three or four white stomatic lines; resin-canals two, marginal; basal sheath ½ in. long, early deciduous.

Cones sub-terminal, sessile, spreading, in clusters of three or four, ovoid-conic, 2 to 2½ in. long; scales spreading widely when open, woody, about ¾ to 1 in. long and ½ to ¾ in. wide, convex from side to side, thin in margin; apophysis thickened, incurved in the centre of the rounded broad upper margin, with a minute dark-coloured or resinous umbo. Seed obovoid, ⅜ in. long, ⅓ in. wide, compressed, brown; wing short and broad, scarcely exceeding ¼ in. long, usually left in part on the scale when the seed falls. Cotyledons 8 to 10. Seedlings very slow in growth for several years.

Var. *pentaphylla*.

*Pinus pentaphylla*, Mayr, *Abiet. jap. Reiches*, 78, t. vi. f. 20 (1890), and *Fremdländ. Park- u. Waldbäume*, 377 (1906); Kent, Veitch's *Man. Coniferæ*, 356 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 577 (1904).

In the northern part of Hondo, Yezo, and the Kurile Isles the tree bears more pendulous larger cones,[1] up to 3½ in. in length, and seeds with a longer wing, up to ½ in. in length. Mayr considers this variety to be a distinct species; but there is great variation in the size of the cones and in the length of the seed-wing; and we have found no constant characters by which the wild and cultivated specimens that we have examined could be clearly separated into two distinct groups. There is no difference in the foliage or the branchlets.[2]

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[1] The timber when imported is known as *yellow pine*, a name used in America for other species, and liable to be confused with yellow deal, a London trade name for the timber of Scots pine from the Baltic.

This species[3] is a native of Japan and the Kurile Islands; the typical form, according to Mayr, being restricted to southern Hondo, Shikoku, and Kiusiu, where it either grows scattered in the beech and chestnut forests, or forms large woods in company with Tsuga. In Kiso he found single trees in woods mainly composed of *Cupressus obtusa.* Sargent[4] says it is a common inhabitant of mountain forests above 5000 ft. elevation, usually occurring singly or in small groves, occasionally reaching a height of 60 or 70 ft., and overtopping the deciduous trees by its handsome head of long, graceful, somewhat pendulous branches. Mayr, however, says that it attains 100 ft. in favourable situations.

The large-coned variety is the prevalent, if not the only form found north of lat. 35°, where it is met with in the great central chain of Hondo, being very common in Kotzuke. Mayr states that it is always found in the broad-leaved forest, never ascending into the fir region, and becoming in deep valleys a tree of the first magnitude, but in elevated regions scarcely higher than 50 or 60 ft. Faurie[5] collected it on the precipitous mountains of Aomori, and Sargent[4] states that it is a rare inhabitant of the mountain forests of southern Yezo.

This species is known in Japan both as *himeko-matsu* and *goyo-matsu*, the former name being restricted in books to the type, and the latter being assigned to var. *pentaphylla*; yet, as is acknowledged by Mayr, in the mountains of the interior the colloquial usage varies, showing that there is little or no difference between the two forms, which only vary in the size of their cones. This pine is cultivated in pots everywhere in Japan, being dwarfed and distorted in many ways. The timber is little used. (A. H.)

I saw this tree in the forest above Agematsu in Kisogawa, at an elevation of about 3000 ft.; and, as I noted at the time, it looked so peculiar in habit and bark, that until I got the leaves and cones I could not believe that it was a pine. The illustration which I give of this tree (Plate 274) was taken for me by Mr. Masuhara of Tokio, and would, I think, be generally taken for a cypress. It was growing alone in a grassy valley, and though not of very large size seemed to be an old tree. In this part of Japan it is scattered here and there among deciduous trees and is not gregarious.

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[1] Cones collected in Yezo by Maries in 1879 and by J. H. Veitch in 1892 are preserved in the Kew Museum, and though larger than those from other localities, differ in no essential character.

[2] Mayr says that in *P. pentaphylla* the branchlets are glabrous, but in the Yezo specimens which we have seen they are distinctly pubescent. In the northern tree, according to Mayr, the bark separates into larger scales.

[3] This species is represented in Formosa by a closely allied species, *P. formosana*, Hayata, in *Journ. Coll. Sc. Tokyo*, xxv. 217 (1908), referred to in *Gard. Chron.* xliii. 194 (1908) as *P. morrisonicola*, Hayata. The Formosan tree has longer leaves (3 to 4 in.) and larger cones, with strongly reflexed scales.

[4] In *Garden and Forest*, viii. 306 (1895) and x. 461 (1897).

[5] Cf. Masters in *Bull. Herb. Boissier*, vi. 270 (1898).

### CULTIVATION

*P. parviflora*[1] was introduced into cultivation in England by John Gould Veitch in 1861. In England, as is the case in Japan, it bears cones at an early age, which render it rather unsightly as an ornamental tree. The seeds ripen early in the season, and are eaten by finches with great avidity. Seedlings have been raised from home-grown seed. The largest tree that I have seen is one at Wilton House which in 1906 was 36 ft. by 3½ ft. At Eggesford, in Devonshire, it forms a large spreading bush. At Blackmoor, at Westonbirt, and many other places I have seen very similar specimens, of from 20 to 30 ft. high, on lawns, and except as a purely ornamental tree it has no value whatever.

At Grafrath, near Munich, the tree is rather fast in growth, and perfectly hardy; but it suffers much from attacks of *Agaricus melleus.*

In New England,[2] *Pinus parviflora* grows rapidly, and resists the most severe cold. There are specimens 20 to 25 ft. in height, which produce cones in profusion. (H. J. E.)

## PINUS CEMBRA, ALPINE PINE

*Pinus Cembra*, Linnæus, *Sp. Pl.* 1000 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2274 (1838); Murray, in Lawson, *Pinet. Brit.* i. 17, t. 3 (1884); Willkomm, *Forstliche Flora*, 169 (1887); Mathieu, *Flore Forestière*, 622 (1897); Kent, Veitch's *Man. Coniferæ*, 317 (1900); Masters, in *Journ. Lin. Soc.* (*Bot.*) xxxv. 583 (1904); Kirchner, Loew u. Schröter, *Lebensgeschichte Blütenpfl. Mitteleuropas*, i. 241 (1905); Clinton-Baker, *Illust. Conif.* i. 14 (1909).

*Pinus sibirica*, Mayr, in *Allgem. Forst- u. Jagdzeitung*, 1900, ex *Fremdländ. Wald- u. Parkbäume*, 388 (1906).

A tree attaining about 130 ft. high in Siberia and 70 ft. in central Europe. Bark of young trees greenish grey, smooth or warty, with resin blisters; on old stems reddish grey, and dividing into thin scaly plates. Buds ovoid, resinous, about ½ in. long, acuminate at the apex, the long subulate free points of the scales being usually appressed together and not spreading as in *P. koraiensis.* Young branchlets with prominent pulvini, and densely covered with an orange-brown shaggy tomentum. Older branchlets roughened by scars and dark in colour.

Leaves[3] in fives, persistent three to five years, densely crowded, more or less spreading or appressed and nearly parallel to the branchlets, 2½ to 3½ in. long, slender, curved, acute or acuminate at the apex; margin with fine and not very close serrulations, which are not continued to the extreme tip; dark green, with inconspicuous whitish stomatic lines on the two inner surfaces; resin-canals three, median.

Staminate flowers sessile, about ½ in. long, yellow; connective violet, serrulate. Young cones, violet, nearly ½ in. long, erect, solitary, or in whorls of two to six.

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[1] Cf. *Gard. Chron.* 1861, p. 265. The cones collected by J. Gould Veitch in 1860, figured by Murray in *Proc. Hort. Soc.* ii. 272, fig. 13 (1862), as well as those collected by Maries in 1879 and by J. H. Veitch in 1892, came from Yezo, and are those ascribed to var. *pentaphylla.* From the seeds of these cones some of the trees in cultivation in this country are derived, yet these invariably bear short cones, like those of the typical form described by Siebold. Similarly, in the Arnold Arboretum, a small tree of *P. pentaphylla*, raised from Yezo seed, has borne short cones.—(A. H.)

[2] *Garden and Forest*, viii. 306 (1895) and x. 461 (1897).

[3] The leaves emit, especially in summer, a very agreeable peculiar odour. Cf. *Gard. Chron.* xx. 301, 309 (1883).

Cones subterminal, short-stalked, never opening, spreading, ovoid, obtuse at the apex, 2 to 3 in. long, 1½ to 2 in. wide, greenish with a violet tinge before ripening, brown when mature. Scales numerous, scarcely woody, brittle, about 1 in. long and ¾ in. broad; apophysis, bent at nearly a right angle to the concealed part of the scale, with semicircular, sharp, and bevelled margin, and minutely tomentose outer surface; umbo terminal, thickened, triangular or rounded.

Seed obovoid, about ½ in. long, dull brown, convex on the lower, flattened on the upper surface, with rounded and scarcely sharp angled sides, wingless,[1] edible. These are distributed by nutcrackers, squirrels, and dormice, who break the scales of the cone, which never open, and carry away the seeds to their larders or holes; and as some are often dropped by the way, seedlings are observed in the Alps and elsewhere at a considerable distance from the parent tree.

## VARIETIES[2]

1. Var. *sibirica*, Loudon (*Pinus sibirica*, Mayr[3]). The tree occurring in Siberia is scarcely to be distinguished by any definite morphological characters from the typical form of central Europe (var. *helvetica*, Loudon), though Willkomm and others state that it has longer cones and larger seeds. The physiological differences are, however, considerable, as the Siberian tree attains a much greater height, forming a narrow pyramidal tree, like *P. Strobus* in habit; and is faster in growth in the young stage, with longer shoots, and more branchlets developed in each whorl. These differences are preserved in trees growing in severe climates, like Scandinavia and Germany; but in this country the Siberian variety is very slow in growth, and does not appear to be long-lived.

2. Several varieties of horticultural origin have been described, as var. *aurea*, *Kew Handlist of Coniferæ*, 127 (1903), and a dwarf form and a single-leaved form, mentioned by Carrière in *Conif.* 389 (1867).

## DISTRIBUTION

This species occurs in two distinct regions, one embracing a vast area in Russia and Siberia, and the other confined to narrow limits in the Alps and Carpathians. In Europe it is widely spread in isolated tracts throughout nearly the whole of the Alps, scarcely ever descending[4] below 5000 ft., and reaching timber line in different places at 6200 to 8000 ft. elevation. In France it is called *arole* or *auvier*, and is confined to the northern part of the Maritime Alps, the high peaks of Dauphiné, the Graian Alps, and Mont Blanc. In the Maurienne, close to Modane, it is well seen in the wild forest of Villarodin Bourget, where it begins at about

[1] Kirchner, *op. cit.* 270, fig. 136, describes and figures the vestiges of the rudimentary wing, which remains attached to the scale.

[2] Var. *pumila* is now considered to be a distinct species, *P. pumila*, Regel. (See p. 1045.)

[3] Mayr relies on trifling differences in the colour of the leaves, and in the shape and colour of the buds, characters which I have not been able to verify. The two trees, one of Swiss, and the other of Siberian origin, in the Christiania Botanic Garden, though strikingly different in habit, show no differences in leaves, buds, or branchlets.

[4] The lowest altitude, according to Dr. Rikli, is 4000 ft., near Raron, in the upper Rhone valley.

5000 ft., where *Pinus sylvestris* and *Abies pectinata* cease to grow, and is common mixed with larch and spruce at about 6000 ft., assuming in this dense part of the forest a narrow pyramidal form. Higher up, at about 7000 ft., it grows nearly pure in groups, scattered amidst rhododendrons, where seedlings are numerous, and is of a much more branching and picturesque habit, while far above on the rocky crests up to 8000 ft. isolated and broken trees are visible on the sky line. The largest specimens, which are at about 7000 ft., are of great girth, one tree which I saw in 1904 measuring 5 ft. in diameter, and dividing at 8 ft. from the ground into two stems. It is about 60 ft. high. Taller trees, up to 70 or even 80 ft., but of lesser girth, occur at the lower levels. Still larger specimens are said to exist in the forest of Arvieux in the same district.

In Switzerland[1] the tree is usually called *Zürbel*, *Zirbe*, or *Arve*; but is named *Schember* in the Engadine, which corresponds to the Italian name *zembra* or *zimbro*. The most extensive woods occur in the great central chain, as in the Pennine Alps and in the Engadine, though the tree is nearly extinct in Tessin; whilst smaller woods and scattered trees are met with in the limestone Alps from Vaud and Freibourg to Chürfürsten in St. Gall. From here the distribution extends through the Bavarian Alps to Salzkammergut, whilst it is continued through the Tyrol in the main chain to Gamstein, on the Styrian frontier, its most northern and eastern station in the Alps. In the southern Alps the tree grows here and there from Mt. Adamello in the Tyrol to Bleiberg in Carinthia and the Steiner Alps in Carniola. Throughout the Alps *P. Cembra* is seen on all formations—granite, slate, limestone, dolomite, etc.—but it thrives best and forms the largest woods on moist soils containing a considerable amount of clay, and remains stunted on dry limestone.

(A. H.)

In the Swiss Alps it is becoming in most places a scarce tree,[2] as the wood is in great request for carving, and the seeds are mostly eaten by mice and birds. But in the high Alps on the south side of the Valais many fine old trees may yet be seen.

A very beautiful one is shown in Plate 275, which is reproduced from a negative lent me by M. Coaz, Chief Inspector of the Swiss Government Forests, and forms plate xvi. of *Les Arbres de la Suisse*. It grows at Muotta da Celerina, near Pontresina, on a formation of mica schist and syenite rocks, at an elevation of 2120 metres, and measures 15 to 16 metres high, with a girth of 4.20 metres. It is divided into three principal stems, with many great branches, which extend to a diameter of 16½ metres, and is surrounded by numerous seedlings, which often grow from seeds dropped by the nutcracker (*Nucifraga caryocatactes*).

By far the best illustrations that I have seen of this tree in its native Alps are a series of twelve plates (27 B to 36 B) in *Vegetationsbilder* 11 (1905), by Dr. L. Klein. Of these the most remarkable is a tree broken off at a few feet up, where it measures 4¼ metres in girth, with eight ascending candelabra-like branches. This grows at

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[1] A very complete account of this pine in Switzerland has lately been published by Dr. M. Rikli, *Die Arve in der Schweiz*, pp. xl + 455, with 21 maps and 60 illustrations (Georg et Cie, Basel, 1909). A review of this important work is given in *Nature*, lxxxii. 399, figs. 1, 2 (1910).

[2] This species, according to Kirchner, *op. cit.* 250, was formerly much more widely spread in the Alps and Carpathians than it is at the present time.

2300 metres behind the Findelen Hotel, on the Riffel Alp. Another decayed tree grows near it, measuring, close to the ground, no less than 7.67 metres (about 25 ft.) in girth, which Dr. Klein computes, from a careful counting of the rings in other trees, to be from 1000 to 1100 years old, and considers to be the oldest recorded tree of the species in Switzerland.[1]

In the Carpathians[2] the woods of *P. Cembra* are smaller in extent and less frequent than in the Alps, occurring from the Tatra mountains in the north to Baiku in Banat, and ranging from 4200 to 7500 ft. altitude.

In north-eastern Russia *P. Cembra* occurs in the plains of Vologda, Viatka, and Perm, to the eastward of a line drawn from the source of the river Vaga to the middle reach of the Petchora in lat. 65°, and often forms extensive forests of tall trees, without a branch to 70 or 80 ft., which are seldom, however, cut for their timber. In the Ural mountains its range is from lat. 64° to lat. 55°.

In Siberia this species occupies a wide territory, its northern limit crossing the Obi at lat. 66°, the Yenisei at 68°, the Lena at 60°, and the Aldan at 55°, and it does not appear to extend farther east than long. 130°, being replaced by *P. pumila* in north-eastern Siberia and Kamtschatka, and by *P. koraiensis* in Amurland, Manchuria, and Korea. The southern limit, beginning in the Ural at lat. 55°, crosses the plain to reach the Alatau, Altai, and Sayan mountains, and, passing south of Lake Baikal, ends in north-eastern Mongolia.[3]

In the Ural Mountains this tree is abundant, though I did not see it myself so far south as the line of the Siberian railway. It occurs in the neighbourhood of Ekaterinburg, where Pallas first described it.[4] He called it the Siberian cedar or pine of Liban, probably confusing it with the true *Cedrus Libani*. He says that it grows so slowly that in a tree only 5 in. 4 lines in diameter he counted sixty-two rings, whilst a larch of fifty-nine years old was only 5 in. 9 lines in diameter. He further states that in the Ural it only produces much seed when two wet seasons occur in succession, and that in marshy places it grows to a much greater size than on the mountains.

Ledebour[5] says that in the south-western Altai this tree ascends from about 4500 ft. to the timber line, which is here about 6500 ft., but this is not the case in the more eastern district of the Altai which I visited, and where, probably on account of the much drier soil, I saw few or no *Pinus Cembra* in the Katuna and Tchuja mountains. But on my return journey it formed a considerable part of the forest on the steep mountains forming the southern shore of the north end of Lake Teletskoi, mixed with *Abies sibirica*, and was frequented by flocks of nutcrackers, which were feeding on its seeds. These seeds are a favourite article of food in Siberia, as well as in the Ural, and were sold in the market at Barnaoul in September.

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[1] Cf. Correvon in *Gard. Chron.* xvii. 80, fig. 12 (1882), who figures an old tree in the Tyrol, about 7 ft. in diameter.

[2] Cf. Pax, *Pflanzenverb. Karpathen*, i. 126 (1898), and ii. 247 (1908). Heuffel saw, just below the alpine pasture of Baiku, the only grove of *P. Cembra* in the whole territory of the Banat Alps. According to Golesco, in *Bull. Soc. Dend. France*, 1907, p. 178, it occurs as a scattered tree in the *P. montana* belt of the mountains of the Muscel district in Roumania.

[3] Radde, *Reisen im Süden von Ost-Sibirien*, 117 (1861), gives the limit of elevation in the East Sayan as 7095 ft. On the mountains of N.W. Mongolia at Sochondo it only attains 6500 ft.

[4] Pallas, *Voyages*, ii. 252 (1789).

[5] *Reise Altai Gebirge*, i. 345-9 (1829). Ledebour, *op. cit.* 144, mentions a tree in the south-west Altai at 5700 ft. altitude, which measured 13 ft. 8 in. in girth at a foot from the ground.

## CULTIVATION

According to Hempel[1] the ripe seeds of the Cembra pine fall with the cones in the early spring, and as a rule lie a year before germinating; but a small proportion of the seeds that I have sown have germinated in England in the first season, and some will remain two or even three years before coming up.

The seedling has nine to twelve, usually ten cotyledons, and makes but a short shoot in the first year. As mice and birds will probably devour the seeds unless protected, it is best to sow them in boxes filled with rich light sandy soil, and covered with fine wire netting. The seedlings should remain two or three years in the boxes, and will require three to five years or more in the nursery before they are large enough to plant out.[2] They are not often injured by spring frosts, but appear to dislike lime in the soil, and the seedlings which I raised from seed brought from Siberia all died at Colesborne, though one which I planted on sand in Norfolk grew much better.

Though a native of climates where the summer is extremely short, and growing naturally on dry rocky situations, the tree seems to want good and fairly deep soil to develop into a fine tree in England, and is usually a very slow grower,[3] though when established it will make growths of 9 to 15 in. annually until it reaches 40 to 50 ft. in height. It does not seem so difficult to transplant as some pines.

## REMARKABLE TREES

This tree is said by Loudon to have been introduced by Archibald Duke of Argyll in 1746; and one of the original seedlings mentioned as being at Whitton in 1838 still survives; and though somewhat crowded by other trees which have prevented it from branching in a natural manner, it is still fairly healthy and the tallest known to us in England, being 80 ft. by 5 ft. when measured by Henry in 1903.

At Walcot in Shropshire, the seat of the Earl of Powis, a large number of this species were planted, according to Lambert, about 1820, having been raised from Swiss seed some years previously; but when I visited this place in 1906 I could not find many survivors, though five or six handsome specimens remain in the grounds, the largest of which were 59 ft. by 8 ft. 11 in., 59 ft. by 8 ft. 10 in., and 65 ft. by 7 ft. 5 in. respectively.

At Oakly Park near Ludlow there is a very well-shaped tree, probably of the same age as those at Walcot, on a steep bank below the house, which, though difficult to measure accurately, is about 70 ft. by 8 ft. 4 in. The trunk of this is much cleaner than usual, and contains about 80 ft. of timber.

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[1] Hempel u. Wilhelm, *Bäume und Sträucher des Waldes*, i. 175 (1889).

[2] In his garden at Stratton Strawless, Mr. W. J. Birkbeck showed me in 1907 some seedlings which he had raised from seeds gathered by him at Tolga Monastery in Russia, which were only about 3 in. high four years after sowing.

[3] Correvon, in *Gard. Chron.* xvii. 80 (1882), states that seeds sown at Vevey, at 300 ft. elevation above Lake Geneva, and at a high altitude in the mountains, produced seedlings markedly different in their rate of growth. Those at the high elevation attained 8 ft. high, while those at Vevey were scarcely 3 ft. high at the same age.

At Barton, Bury St. Edmunds, there is a tree planted in 1825, which is 57 ft. by 5 ft. 1 in. At Linton Park, Kent, a tree which was the largest reported to the Conifer Conference in 1891, when it measured 68 ft., when I saw it in 1903 was only 70 ft. by 4 ft. 6 in., and did not look at all healthy.

At Woburn there is a very healthy specimen, branched to the ground, which in 1903 measured 53 ft. by 8 ft. 6 in. At Dropmore a tree said by Loudon to have been about 40 ft. high is now about 60 ft. At Osberton Hall, Notts, there is an old tree 50 ft. by 6 ft. 2 in.

At Essendon Place, Herts, Mr. Clinton-Baker in 1907 measured a specimen 60 ft. by 5 ft. 4 in. At Bayfordbury a tree planted in 1840, is now 41 ft. by 5½ ft.

In Scotland this tree does not seem to have been much planted at an early date, and I have heard of no trees of great age; but it seems to have been a great favourite with the late Queen Victoria and the Prince Consort, and a great number of thriving specimens are growing at Balmoral, where the soil and climate seem to suit it remarkably well, and where it ripens good seed. There is an avenue 12 yards wide from the stables to the back door of the castle, which Mr. Michie believes to be fifty years old, and the trees, planted 6 yards apart, averaged in 1904, 38 to 40 ft. high by 3 to 4 ft. in girth. A much larger tree grows on the north side of the castle, and a number of the trees planted by royal and distinguished visitors in memory of their visits are of this species. This seems to show what I have not noticed in England, that a cold climate and dry sandy soil are, as might be expected, favourable to the health of this tree.

At Abercairney, in Perthshire, Henry measured a tree 55 ft. high by 5 ft. 7 in. in girth; and Hunter records one at Cultoquhey near Crieff, planted out from a pot in 1826, which in 1883 was 40 ft. by 6¼ ft.

In Ireland the damper climate does not seem to suit it, as we have not seen any trees of considerable size.

A tree planted in the Park of Bogstad near Christiania, which Schübeler thought to be about 100 years old, and which he says was in 1885, 60 ft. high, was, when I measured it in 1903, about 85 ft. high with a trunk 10 ft. in girth, and divided at about 30 ft. into four stems. It is the largest cultivated tree that I have seen anywhere, and shows that it might prove a valuable forest tree in Norway.

There is in the Botanical Garden at Christiania a tree believed to be of the Siberian variety which looks healthier, and is growing faster, than the European form. When I saw it in 1903 it was growing at the rate of about a foot per annum, and according to Schübeler is now about forty-one years old. This variety was growing healthily but slowly at the forest nursery at Storgaard in the upper part of Saltdalen, latitude 67°.

## TIMBER

The wood of this tree is almost unknown in England except in the form of carvings and toys, for which it is preferred in its native country to that of any other conifer, on account of its softness, density, and the absence of hard rings. It is, however, difficult to procure in large sizes without knots; and among a large quantity of this timber which I saw at Innsbruck, I could not find a log that would cut into clean boards over a foot wide.

It is used in the Tyrol for wainscoting and domestic furniture on account of its durability and fragrance, which is said to endure for a very long period.

Seebohm,[1] who found this tree growing on the Yenesei as far north as latitude 67½°, says that the timber has a much higher market value than that of *P. sylvestris*, and is the best timber found in Siberia. It is dark in colour, but not so dark as larch, and is reputed never to rot, shrink, warp, or crack. It is soft and easy to work, fine in grain, and almost free from knots. (H. J. E.)

## PINUS KORAIENSIS, Korean Pine

*Pinus koraiensis*, Siebold et Zuccarini, *Fl. Jap.* ii. 28, t. 116 (excl. figs. 1-4) (1844); .Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 504 (1881), and xxxv. 582 (1904); Mayr, *Abiet. jap. Reiches*, 73, t. v. f. 18 and t. vi. f. 18 (1890), and *Fremdländ. Wald- und Parkbäume*, 386 (1906); Shirasawa, *Icon. Ess. Forest. Japon*, text 12, t. ii. ff. 17-33 (1900); Kent, Veitch's *Man. Coniferæ*, 334 (1900); Komarov, *Fl. Manshuriæ*, i. 183 (1901); Clinton-Baker, *Illust. Conif.* i. 28 (1909).

*Pinus mandshurica*[2] Ruprecht, in *Bull. Phys. Math.* xv. 382, and *Mél. Biol.* ii. 567 (1857); Maximowicz, *Prim. Fl. Amur.* 263, 393 (1859), and *Mél. Biol.* xi. 349 (1881).

A tree, attaining in Manchuria 150 ft. and in Japan 100 ft. in height, with a trunk 9 ft. in girth, but usually considerably smaller. Bark reddish grey, not unlike that of a spruce, with scales about 4 in. long and 2 in. broad, the freshly peeled places being reddish brown in colour. Buds, ½ to ¾ in. long, cylindric-ovoid, resinous, bristly at the apex, owing to the long subulate free points of the scales. Young branchlets covered with a reddish brown tomentum, and similar to those of *P. Cembra*, but with the pulvini less prominent; older branchlets brownish or grey, and much smoother than in that species.

Leaves similar to those of *P. Cembra* in number, size, persistence, arrangement, and structure; differing in the blunter apex,[3] which is closely and sharply serrulate to the extreme tip, the apex in *P. Cembra* being long-acuminate, more remotely and less sharply serrulate, and often entire at the extreme tip as viewed with a lens. The leaves of *P. koraiensis* are whiter on the inner surfaces than in *P. Cembra*, the stomatic lines being more numerous and more conspicuous, and occasionally show a few broken lines of stomata on the outer surface near the apex.

Staminate flowers in clusters, ⅘ in. long, pinkish. Female flowers upright, reddish, about an inch long, on stout stalks about ½ in. long.

Cones subterminal, but often becoming lateral by the growth of a summer shoot, on short stalks, ovoid-cylindrical, 5 to 6 in. long, and about 3 in. in diameter at the base, opening when ripe. Scales, 1½ to 2 in. long, 1 in. broad, woody;

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[1] *Siberia in Asia*, 234 (1882).

[2] This is identical with *P. koraiensis*, as pointed out by Maximowicz, *Mél. Biol.* xi. 349 (1881); and this opinion is shared by Komarov.

[3] In the apical centimetre of the leaf the serrations average seventeen in *P. koraiensis* and only four in *P. Cembra*.

apophysis shining brown, broadly triangular, reflexed in its upper third, tipped by a resinous thickened umbo. Seed $\frac{9}{16}$ in. long, $\frac{1}{3}$ in. wide, obovoid, sharply angled on the two sides and on the upper margin, wingless, brownish, edible.

This species closely resembles *P. Cembra*, though the cones are very distinct; but differs in the bristly buds, more silvery foliage, smoother branchlets, and faster growth in this country; and examination with a lens will show the different character of the apex of the leaf in the two species.

Var. *variegata*.[1]—A form introduced from Japan, in which the leaves when young are yellowish white in colour, and said to be liable to injury if planted in a place exposed to full sunshine. Though mentioned in the *Kew Handlist*, we have seen no specimens of this variety.

## DISTRIBUTION

*Pinus koraiensis* is widely distributed in eastern Asia,[2] occurring in Amurland, Manchuria, Korea, and Japan. It is not a native of China, being represented in that country by *P. Armandi*, with which it has been much confused by several authors.[3]

Its northern limit in Amurland is, according to Maximowicz, about 51½° lat. in the interior in the Bureja range, and about 49° on the coast. In Manchuria, according to Komarov, it grows throughout the mountain forests, extending westward to the valleys of the Chun-dsien[4] and Sungari rivers, and southwards to the middle valley of the Yalu river; often growing in extensive forests mixed with *Picea ajanensis*, *Abies holophylla*, and many species of deciduous trees, between 500 and 5000 ft. altitude. It attains a great size, up to 150 ft. in height, and the wood is highly valued by the Chinese settlers in Manchuria, and is exported for making coffins and for building purposes. Timber which we believe to be of this tree, resembling that of *P. Cembra*, has lately been imported from Nikolaievsk to London, and is considered likely to serve as a good substitute for the wood of *P. Strobus*, if it can be procured in quantity of a good size. In Korea the pine attains its southern limit in the district of Kang-ge, and was seen by Mr. J. H. Veitch in 1892 wild in various localities, notably in the Diamond mountains, where it is very abundant.[5] The seeds, which are much used by the Koreans, have been sent to Kew by Consul Carles. They are known to the Chinese in the north as *Hai-sung-tze*.

This tree was long believed by the Japanese[6] to be an exotic in Japan, brought from Korea by the soldiers who invaded that country. It is now known to be a native of the great forests of central Japan, where it usually grows mixed with deciduous trees, and occasionally ascends into the higher region of firs and spruces. Mayr saw large trees wild in Kiso and in the virgin forests of the mountains of Kotzuke. It is largely planted in Japan as an ornamental tree, the finest specimens being reputed to be those in a temple grove at Chusenji near Nikko, which measure about 100 ft. in height and 10 ft. in girth, with clean stems of 30 to 40 ft.

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[1] *Gard. Chron.* i. 710 (1887).

[2] This species has been erroneously supposed to grow in Kamtschatka and the Karagin Island, where the only pine known is *P. pumila*, Regel. Cf. Maximowicz, *Mél. Biol.* xi. 349 (1881).

[3] *P. koraiensis* is erroneously stated to be a native of China in Veitch's *Man. Coniferæ*, 335, in *Gard. Chron.* xxxiii. 34 (1903), *Journ. Bot.* 1903, p. 269, etc. Beissner's record of it from Shensi is also incorrect. Cf. synonymy given under *P. Armandi*.

[4] An affluent of the Yalu.

[5] Kent, Veitch's *Man. Coniferæ*, 335 (1900).

[6] It is known in Japan as *Chosen-matsu*, *i.e.* Korean pine.

### CULTIVATION

This tree was introduced in 1861 from a Japanese nursery by J. Gould Veitch.[1] It appears to be perfectly hardy, but rather slow in growth. The best specimens known to us are growing in Ireland—one at Fota, which was, in 1903, 32 ft. high, with a girth of 2 ft. 2 in.; and another at Kilmacurragh, 40 ft. by 2 ft., in 1907, when it bore cones. A tree at Bicton, 34 ft. high by 2 ft. in girth in 1908, has produced cones, with fertile seed, from which a seedling was raised three years ago. A good specimen at Highnam, about 25 ft. high, was bearing cones in March 1910. Another at Grayswood, planted in 1882, is 24 ft. by 1 ft. 4 in.; and one at Tregrehan is 20 ft. by 1 ft. We know of none in Scotland.[2]

At Segrez in France there is a fine specimen, which in 1904 was 40 ft. high and 4 ft. in girth. It has peculiar epicormic branches on the trunk, and bears cones and good seeds, from which plants have been raised. At Ansorge's nursery, Flottbeck, near Hamburg, there is a tree 25 ft. high, which has produced fertile seed.

It is perfectly hardy in New England,[3] and on account of its dense foliage is very ornamental. It produces freely cones and good seeds. The finest specimen, which is growing in Mr. Hunnewell's pinetum at Wellesley, Massachusetts, was 38 ft. high in 1905, and was bearing cones when I saw it in 1906. (A. H.)

## PINUS ARMANDI

*Pinus Armandi*, Franchet, *Plantæ Davidianæ*, i. 285, pl. 12 (1884), and in *Journ. de Bot.* xiii. 254 (1899); Beissner, in *Mit. deut. dend. Ges.* 1896, p. 68, *Nuov. Giorn. Bot. Ital.* iv. 184, t. 5, f. 2 (1897), and *Bull. Soc. Bot. Ital.* 1899, p. 310; Masters in *Journ. Linn. Soc.* (*Bot.*) xxvi. 549 (1902), xxxv. 582 (1904), in *Gard. Chron.* xxxiii. 66, figs. 30, 31 (1903), and in *Journ. Bot.* 1903, p. 269; Clinton-Baker, *Illust. Conif.* i. 6 (1909).

*Pinus Armandi*, Franchet, var. *Mastersiana*, Hayata, in *Tokyo Journ. Coll. Science*, xxv. 216, fig. 8 (1908).

*Pinus quinquefolia*, David, *Voyage en Chine*, i. 192 (1875), and in *Nouv. Archiv. Muséum*, vii. 95 (1884).

*Pinus scipioniformis*,[4] Masters, in *Bull. Herb. Boissier*, vi. 270 (1898).

*Pinus koraiensis*, Masters, in *Gard. Chron.* xxxiii. 34, figs. 18, 19 (1903), in *Journ. Bot.* xli. 269 (1903), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 582 (1904) (in part); Beissner, in *Bull. Soc. Bot. Ital.* 1899, p. 310; Diels, *Flora von Central-China*, 215 (1901). (Not Siebold et Zuccarini.)

*Pinus Mastersiana*, Hayata, in *Gard. Chron.* xliii. 194 (1908).

A tree, attaining 60 ft. in height, with smooth and greenish bark. Buds cylindrical, obtuse, either non-resinous and bristly with free long-pointed scales, or resinous with appressed scales. Young branchlets smooth, olive green, glabrous or with minute scattered hairs, becoming dark grey in the second year. Leaves in fives, spreading, and often bent as in *P. excelsa*, 4 to 6 in. long, green on the convex surface, conspicuously white with stomatic lines on the two flat surfaces, serrulate; resin-canals usually median; basal sheath and scale-leaves early deciduous.

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[1] *Gard. Chron.* 1861, p. 1114; *Hortus Veitchii*, 90 (1906).

[2] The tree at Ochtertyre, reported in *Journ. Roy. Hort. Soc.* xiv. 534 (1892) as being 13 ft. in height in 1891, cannot now be found, and may have been wrongly named.

[3] *Garden and Forest*, 1897, p. 296.

[4] This species is based on a specimen of *P. Armandi*, with young cones, collected by myself. The aberrant position of the resin-canals in some of the leaves, noticed by Masters, is not unusual. Cf. Franchet, *Journ. de. Bot.* loc. cit.

Staminate flowers cylindrical, ¾ in. long, yellow, with spatulate scarious scales at the base.

Cones sub-terminal, on stalks about an inch long, pendulous or spreading, cylindrical, but tapering to an obtuse apex, 4 to 7 in. long, 2 to 3 in. in diameter. Scales rigid, woody, about 1¼ in. long and 1 in broad; concealed part broadly triangular, reddish brown; apophysis triangular, yellow, tipped with a minute brown mucro; apex of the scale rounded and not reflexed, or shortly cuspidate and slightly reflexed. Seed edible, wingless, ½ in. to ⅝ in. long, mottled black on the convex surface, dark brown on the flatter surface, girt all round with a very narrow sharp ridge.[1]

This species[2] is variable in the size of the cones, and in the shape of the scales, which are, however, never so much reflexed at the apex as in *P. koraiensis*. The foliage resembles that of *P. excelsa*; but the resin-canals are marginal in the latter species. The grey-coloured branchlets, which are either glabrescent, or show under the lens a very scattered minute pubescence, are characteristic of *P. Armandi*; and are very different from the glaucous glabrous branchlets of *P. excelsa*, or the reddish brown tomentose branchlets of *P. koraiensis*.

This species is widely spread throughout the mountains of western China, at elevations of 4000 to 6000 ft., from lat. 34° in Shensi to lat. 23° in Yunnan. It usually grows on wooded cliffs or on rocky situations, scarcely ever forming pure woods, and seldom attaining more than 50 ft. in height and 6 ft. in girth. The wood is used for building and for the coarser kinds of furniture; and the edible seeds are sometimes sold in the markets. It is called *kuo-sung* (fruit-pine) in Yunnan, and *ts'ung* or *niu-sung* (cow-pine) in Hupeh. It is one of the remarkable discoveries made by Père David in his third journey through China in 1873, when he first saw it in the Tsin-ling range, south of the Yellow River in Shensi, where it has since been collected by Père Giraldi. It was subsequently found by Père Delavay and myself in Yunnan and Hupeh, and by Père Farges, von Rosthorn,[3] and Wilson in Szechwan.

This species has lately been discovered by several Japanese botanists in Formosa, where it grows on Mount Morrison at altitudes ranging from 8000 to 10,600 ft. The Formosan tree bears cones with scales slightly reflexed at the tip, as is commonly the case in Yunnan specimens, and on that account has been distinguished as a variety[4] by Hayata.

Père Farges sent seeds of this species in 1895 to M. Maurice L. de Vilmorin, who informs me that the largest specimen raised from this introduction is growing at Harcourt (Eure), and is now about 8 ft. high, and producing annual shoots about a foot in length. There are smaller trees at Les Barres and Verrières. There are also specimens of the same origin at the Arnold Arboretum, and some of these sent by Professor Sargent in 1902 to Kew are only about 2½ ft. in height. A tree from the same source planted at Colesborne in 1905 has gradually pined away, possibly on account of the limy soil.

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[1] This rim-like margin is absent in the seeds of *P. koraiensis*.

[2] Some of Père Giraldi's specimens, which I saw in the museum of Florence, have been considered by Beissner to be *P. koraiensis*, on account of their short leaves; but in the branchlets, cones, and seeds they are indistinguishable from *P. Armandi*.

[3] Diels, *Flora von Central-China*, 216 (1901).

[4] Var. *Mastersiana*, Hayata, in *Tokyo Journ. Coll. Science*, xxv. 216, fig. 8 (1908); *Pinus Mastersiana*, Hayata, in *Gard. Chron.* xliii. 194 (1908).

The finest specimens of this species in cultivation are seven trees at Kew, which were raised from seed sent by me from Mengtse in Yunnan in 1897. They are 10 to 15 ft. high; and three of them bore fully developed cones in 1909. Wilson[1] sent seeds from Hupeh to the Coombe Wood Nursery in 1900, and the seedlings raised are about 2½ ft. high and very flourishing. *P. Armandi* promises to be a valuable ornamental tree. (A. H.)

## PINUS PUMILA

*Pinus pumila*, Regel, in *Cat. Sem. Hort. Petersb.* 23 (1858), and in *Bull. Soc. Nat. Mosc.* xxxii. 1, p. 211 (1859); Mayr, *Abiet. jap. Reiches*, 80, 103, t. vi. fig. 21 (1890); Komarov, *Fl. Mansh.* 189, 190, 214 (1901); Clinton-Baker, *Illust. Conif.* i. 46 (1909).

*Pinus pygmæa*, Fischer, *ex* Endlicher, *Syn. Conif.* 142 (1847).

*Pinus Cembra*, Linnæus, var. *pumila*, Pallas, *Flora Rossica*, i. 3 (1784); Kent, Veitch's *Man. Conif.* 318 (1900).

*Pinus Cembra*, Linnæus, var. *pygmæa*, Loudon, *Arb. et Frut. Brit.* iv. 2276 (1838); Fischer, in Middendorf, *Reise*, *Flora Ochot.* 88 (1856).

*Pinus mandshurica*, Murray, in Lawson, *Pin. Brit.* i. 61 (1884). (Not Ruprecht.)

A shrub, usually prostrate, and rarely if ever exceeding 10 ft. in height. Buds resinous, about ¼ in. long, cylindric-conic, ending in a sharp-pointed apex; scales reddish brown, closely appressed. Branchlets covered with a dense brown tomentum. Leaves closely crowded on the branchlets and directed forwards, parallel with them, in fives, those in each cluster appressed together, incurved, 1½ to 2, rarely 3 in. long, white with stomatic lines on the two inner surfaces, entire or faintly serrulate[2] in margin; resin-canals marginal; basal sheath entirely deciduous.

Cones never opening, sub-sessile, about 1½ in. long and 1 in. in diameter, ovoid, often curved, reddish or orange brown when ripe; scales few, about $\frac{6}{10}$ in. broad, concave interiorly with a partition between the cavities for the seeds, upper edge sharp and bevelled; umbo terminal, darker in colour than the rest of the apophysis, ending in a minute, thickened, triangular, reflexed tip. Seed about ¼ in. long, pear-shaped, convex on the lower, and flattened on the upper surface, brownish, wingless, edible.

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[1] Cf. *Hortus Veitchii*, 343 (1906). Seeds of this species, erroneously ascribed to *P. koraiensis*, were sent by Wilson in 1899 from Yuanchiang in Yunnan, but do not appear to have germinated. Kent, in Veitch's *Man. Coniferæ*, 335 (1900), also erroneously considers the Yunnan tree to be *P. koraiensis*.

[2] Specimens from Japan show both entire and serrulate leaves. Those from other regions have apparently always entire leaves. The cones are identical.

This pine, which always remains a shrub, is distinct from *P. Cembra*, in the small size and different shape of the cones and seeds, and in the position of the resin-canals in the leaves, which are shorter, and entire or serrulate in margin.

It is widely spread[1] in eastern Asia, occurring in Kamtschatka, Siberia to the eastward of Yakutsk, Amurland, northern Russian Manchuria, Saghalien, Kurile Isles,[2] and Japan. It is a native of very cold regions, growing as a dense scrub on wind-swept plateaux or on mountains close to the snow-line. In Kamtschatka[3] and the Kurile Isles to the north of Urup, it thrives where no other pine is known, at elevations little above sea-level. In Iturup it grows between 1000 and 3000 ft. elevation, and in Yezo at over 3000 ft. In central Hondo it is confined to mountain peaks over 7000 feet elevation, and is often seen in the vicinity of sulphur springs, the poisonous exhalations of which it bears without injury.

It is known to the Japanese as *Hai-matzu*, and to the Ainus as *Todonup* or *Henekkeri*; and its seeds[4] are much esteemed by the natives of the Kurile Isles as an article of diet.

This species appears to have been early introduced into St. Petersburg from eastern Siberia; and Loudon mentions a plant at Dropmore which was only 6 in. high in 1837, though twenty years old, and had increased to 8½ in. in height in 1866 when it was examined by Murray. The latter procured seeds for sowing in this year from Regel, but we have not found any specimens now living in England.

Specimens with cones and seeds have lately been sent home by Capt. L. Clinton-Baker, R.N., who procured them from Nyoho San, near Nikko, at 8000 ft. elevation; and two plants[5] from this locality have been planted at Bayfordbury.

(A. H.)

## PINUS FLEXILIS

*Pinus flexilis*, James, in *Long's Exped.* ii. 34 (1823); Murray, in *Gard. Chron.* iii. 106, and iv. 356 (in part), f. 75 (1875); Sargent, *Silva N. Amer.* xi. 35, tt. 546, 547 (1897), and *Trees N. Amer.* 7 (1905); Kent, Veitch's *Man. Coniferæ*, 330 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 589 (1904); Clinton-Baker, *Illust. Conif.* i. 21 (1909); Shaw, *Pines of Mexico*, 12 (1909).

A tree, usually 40 to 50, occasionally 80 ft. high, with a short trunk 6 to 15 ft. in girth. Bark of young stems and branches thin, smooth, grey or silvery white; becoming on old trunks 1 or 2 in. thick, dark brown, and deeply fissured into broad, scaly ridges. Branches very tough and flexible. Buds ovoid, short-pointed, ⅝ in. long, resinous, with the scales appressed or free at their subulate tips. Young branchlets glabrous or covered by a minute dense brown pubescence.

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[1] It is said by Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 505 (1881), to have been found on the bay of Kotzebue in Alaska, but we have been unable to confirm this report.

[2] Miyabe, *Flora of the Kurile Isles*, 261 (1890).

[3] This species was early mentioned by Abbé Chappe d'Auteroche, who, in *Voyage en Sibérie*, i. 360 (1768), says that little cedars, creeping on the ground and never growing upright, are found on the mountains and moss-covered plains of Kamtschatka. The inhabitants gather large quantities of the seed for food, and make a drink, something like *kwas*, by boiling and fermenting the young shoots, considered to be a cure for scurvy.

[4] Batchelor and Miyabe, *Ainu Economic Plants*, 230 (1893).

[5] One of these plants is figured in *Gard. Chron.* xlvi. 93, fig. 41 (1909).

Leaves in fives, persistent for five or six years, densely crowded on the branchlets, directed forwards, 2 to 3 in. long, stout, rigid, curved, scarcely twisted, entire[1] in margin, sharp-pointed, marked on the three surfaces with three or four stomatic lines; resin-canals marginal; basal sheath $\frac{1}{2}$ in. long, early deciduous.

Cones sub-terminal, erect when young, spreading in the second year, sub-sessile, 3 to 5, rarely 10 in. long,[2] ovoid-cylindrical; scales[3] opening and spreading horizontally when mature, about 1 in. long and $\frac{3}{4}$ in. wide, obovate, with the upper margin reflexed; apophysis thickened, brown, tipped with a triangular umbo. Seed ovoid, compressed, $\frac{1}{3}$ to $\frac{1}{2}$ in. long, brownish, angled on the lateral and upper margins; wing rudimentary, about $\frac{1}{12}$ in. long, lacerated when the seed falls.

This species is distinguished from all the cultivated five-leaved pines with a completely deciduous leaf-sheath, except *P. pumila*, by the leaves being entire in margin. The latter species, which in its continental form has also non-serrulate leaves, is readily distinguishable from *P. flexilis* by the shaggy reddish brown tomentum on its young branchlets.

## VARIETY

Shaw considers the following to be a variety of this species:—

*Var. reflexa*, Engelmann, in Rothrock, *Rep. Geol. Surveys*, vi. 258 (1878).

*Pinus reflexa*, Engelmann, in *Bot. Gazette*, vii. 4 (1882); Mayr, *Fremdländ. Wald- u. Parkbäume*, 388 (1906).

*Pinus strobiformis*, Sudworth, *U.S. Forestry Bull.* No. 14, p. 17 (1897) (not Engelmann[4]); Sargent, *Silva N. Amer.* xi. 33, tt. 544, 545 (1897), and *Trees N. Amer.* 6 (1905).

This differs from the type in the much reflexed, usually thin cone-scales. The leaves, either entire or serrulate in margin, are with or without stomatic lines on the back. It was found in northern Chihuahua in Mexico by Pringle in 1887, and seems to be intermediate between *P. flexilis* and *P. Ayacahuite*, though all the cones seen by Shaw resembled those of *P. flexilis* in size and general appearance. According to Sargent, this pine attains 80 to 100 ft. in height, and is scattered singly, or in small groups, on rocky ridges of the Santa Catalina, Chiracahua, and Santa Rita mountains of southern Arizona, and on the Sierra Madre of Chihuahua in Mexico. It has not been introduced.

## DISTRIBUTION AND CULTIVATION

This species is widely distributed on the eastern slope of the Rocky Mountains[5] from Alberta to Texas, and occurs also in the mountains of northern Arizona, Utah,

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[1] In rare cases the leaves are slightly serrulate, and have been distinguished as var. *serrulata*, Engelmann, in Rothrock, *Wheeler's Report*, vi. 258 (1878).

[2] Cones of abnormal length, in addition to those of the ordinary size, are produced on trees growing in the San Francisco mountains of northern Arizona; and have been distinguished as var. *macrocarpa*, Engelmann, in Rothrock, *Wheeler's Report*, vi. 258 (1878).

[3] Shaw, *loc. cit.*, says: Scales straight or reflexed, and variable in thickness.

[4] *P. strobiformis*, Engelmann, is a variety of *P. Ayacahuite*.

[5] In the Rocky Mountains of Canada *P. flexilis* is found only on the margins of the rivers issuing from the mountains. Cf. Macoun, in *Trans. R. Soc. Canada*, xii. 4, p. 13 (1894).

Nevada, and south-eastern California, where it reaches the western side of the Sierra Nevada at the head of King's River. It occupies the sub-alpine zone, usually growing singly or in small groups, but forming open forests on the eastern foot hills of the Rocky Mountains in Montana and on the ranges of central Nevada. At low elevations it is associated with *P. contorta*, var. *Murrayana*, and at higher altitudes in the southern part of its area is often scattered with *P. aristata*. In Colorado, according to Engelmann, it has a tapering trunk, branching almost from the base, and attaining, at 200 or 300 years old, a diameter of one foot. It is largest in size in Arizona and in northern New Mexico, where Fendler saw it 60 to 80 ft. in height.[1] In the Sandia Mountains[2] in this state it ascends to 12,000 ft.; but in the north is restricted to elevations of 4000 to 6000 ft. It also occurs in a limited area in northern Mexico, where it was collected in Coahuila by Nelson. Sargent figures[2] a fine tree, growing in the Yellowstone Park, at 7000 ft. elevation, which was 5 ft. in diameter.

*P. flexilis* was discovered in 1820 by Dr. Edwin James, near the base of Pike's Peak in Colorado. Plants[3] were raised in the Harvard Botanic Garden from seeds collected in Colorado by Dr. Parry in 1861, but after thirty-five years' growth were not more than 5 ft. high with tufts of stunted foliage on the ends of naked branches. There are three trees in Kew Gardens, probably of the same origin, growing near the Isleworth gate, one of which produced cones[4] for the first time in 1896, when it was 25 ft. high and 2 ft. in girth. This tree produces fruit every year, and is now 32 ft. by 2 ft. 10 in. At Highnam, a specimen, about 20 ft. high, has borne cones. There are also two trees at Terling Place, Essex, the origin of which is unknown. Both were bearing cones in 1907, the larger measuring 32 ft. by 2 ft. 4 in. They have smooth green bark and ascending branches. There are four trees about 15 ft. high at Westonbirt which are not thriving. Elwes saw a small tree at Murthly in 1906. (A. H.)

## PINUS ALBICAULIS, White-Bark Pine

*Pinus albicaulis*, Engelmann, in *Trans. St. Louis Acad.* ii. 209 (1863); J. D. Hooker, in *Gard. Chron.* xxiv. 9, f. 2 (1885); Sargent, *Silva N. Amer.* xi. 39, t. 548 (1897), and *Trees N. Amer.* 8 (1905); Kent, Veitch's *Man. Coniferæ*, 310 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 588 (1904).

*Pinus flexilis*, Balfour, *Bot. Exped. Oregon*, 1, t. 2, f. 1 (1853) (not James).

*Pinus flexilis*, James, var. *albicaulis*, Engelmann, in Brewer and Watson, *Bot. California*, ii. 124 (1880).

*Pinus Shasta*, Carrière, *Conif.* 390 (1867).

A tree, attaining 80 ft. in height and 12 ft. in girth, usually smaller, and becoming at very high elevations a low shrub.[5] Bark of young trees white or pale grey, smooth; on old trees remaining thin and scaling in small polygonal plates. Young branchlets reddish brown, with a scattered minute stiff pubescence. Leaves similar to those of *P. flexilis*, persisting five to eight years.

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[1] *Trans. St. Louis Acad. Science*, ii. 208, 209 (1863).

[2] *Garden and Forest*, x. 162, fig. 19 (1897).

[3] *Ibid.* 461.

[4] *Garden*, li. 73 (1897).

[5] On high cold sites, as in northern Montana, where I saw this pine in 1906, it dwindles in size till at absolute timber line it is prone on the ground in the depressions of the rock, with matted branches and a stem less than a foot in height.

Cones sub-terminal, sessile, spreading, never opening, ovoid, 1½ to 3 in. long, dark purple when growing, light brown when mature; scales much thickened, very brittle at their base, ¾ in. long, ⅝ in. broad, many undeveloped and unfertile; apophysis triangular, ending in a sharp-pointed umbo. Seed, ⅓ to ½ in. long, ovoid, more or less compressed, pointed at the apex, pubescent; wing rudimentary or absent.

In the absence of cones, this species is best distinguished from *P. flexilis* by the minute scattered stiff hairs on the reddish brown branchlets. The young branchlets of *P. flexilis* are either quite glabrous or covered with a soft fine tomentum.

This species is more alpine in distribution than *P. flexilis*, forming the timber line on many mountain ranges from lat. 53° in Alberta and British Columbia,[1] southward along the Rocky Mountains to the Yellowstone plateau, and through Washington and Oregon in the Cascade and Blue mountains, and in California, along the Sierra Nevada to the San Bernardino mountains. It reaches an elevation of 5000 ft. in the north, and 12,000 ft. in the south. This species[2] endures great seasonal ranges of temperature from −60° to 100° Fahr.; severe winds and a very short growing season being characteristic of its habitat. It is probably the least exacting of all conifers as regards both soil and moisture—the annual precipitation, a large proportion of it in the form of snow, sometimes being as little as 15 in.

In north-western Montana this species[3] does not cross the continental divide, and grows at elevations between 6000 and 8000 ft., usually in scattered groves, either pure or mixed with *Picea Engelmanni* and *Abies lasiocarpa*. It is often seen on high exposed ridges, and strongly resembles *P. Cembra* in general appearance, being often irregularly branched and with a flattened crown of foliage. The largest tree (Plate 276) measured by me on Mount Nicholas, and photographed by Prof. Elrod, was 84 ft. high and 9 ft. 2 in. in girth.

Sir Joseph Hooker describes and figures[4] this tree on Mount Shasta, where the trunk becomes scored and polished by the sand blasts. Elwes saw it here in 1904 at about 7000 to 8000 feet elevation.

The most remarkable feature of this pine, in which it resembles *P. Cembra*, is that the cones never open, the seeds being distributed by squirrels, who readily break off the scales, which are very brittle towards the base.

*P. albicaulis* was discovered[5] on the mountains rising above the valley of the lower Fraser river, near Fort Hope, in 1851 by John Jeffrey, who sent seeds from Mount Shasta, California, in 1852, to Scotland, from which a few plants were raised, but none of these appear to have survived. The only specimens we know in cultivation are seedlings at Kew about 6 in. high.

The timber when accessible is used by miners for props, fuel, and sleepers.

(A. H.)

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[1] Dawson, in *Canad. Naturalist*, ix. 328 (1881) says: "In the coast or Cascade ranges as far north as the Iltasyouco river (lat. 53°)."

[2] Cf. *U.S. Sylvical Leaflet* 37, *White Bark Pine* (1908).

[3] It occurs also in the Helena National Forest in Montana.

[4] *Gard. Chron.* xxiv. 9, fig. 2 (1885).

[5] Sargent, *Silva N. Amer.* xi. 41 (1897).

## PINUS BUNGEANA

*Pinus Bungeana*, Zuccarini, *ex* Endlicher, *Syn. Conif.* 166 (1847); Murray, *Pines and Firs of Japan*, 18 (1863); Hance, in *Journ. Linn. Soc.* (*Bot.*) xiii. 87 (1873); Maximowicz, *Mél. Biol.* xi. 348 (1881); Masters, in *Gard. Chron.* xviii. 8, figs. 1, 2 (1882), in *Journ. Linn. Soc.* (*Bot.*) xxvi. 549 (1902), and xxxv. 590, pl. 23, fig. 10 (1904); Lavallée, *Arbor. Segrezianum*, 111, t. 32 (1885); Kent, Veitch's *Man. Coniferæ*, 316 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 372 (1906); N. E. Brown, in *Bot. Mag.* t. 8240 (1909); Clinton-Baker, *Illust. Conif.* i. 11 (1909).

*Pinus excorticata*, Lindley and Gordon, in *Journ. Hort. Soc.* v. 217 (1850).

*Pinus Napoleoni*, Simon, in *Bull. Soc. d'Acclim.* 1863, p. 281.

A tree, attaining in China 80 to 100 ft. in height, and 12 ft. in girth. Bark on young trees dark brown, smooth, and scaling off in thin flakes, exposing the whitish inner cortex; in old trees white[1] externally, as if washed with lime and marked by inconspicuous scattered brown lenticels; on the inner surface it is fawn-coloured and covered with minute resinous depressions. Buds spindle-shaped, brown, about ⅜ in. long, slightly resinous; external scales few, lanceolate, acuminate, free at the tips. Young branchlets glabrous, greenish, with slightly raised pulvini, which disappear in the second year, leaving the surface smooth and greyish green.

Leaves in threes, with the basal sheaths entirely deciduous early in the first year, remotely placed on the branchlets, persisting three or four years, about 3 in. long, rigid, curved, serrulate, sharp-pointed, marked with stomatic lines on the three surfaces; fibro-vascular bundle undivided; resin-canals four, marginal.

Staminate flowers in a loose spike, about 4 in. long; each flower ¼ in. long, girt at the base by ovate-triangular acute bracts.

Cones, solitary or in pairs, sub-terminal, though often becoming apparently lateral by the growth of a summer shoot, on stout short stalks; globose-ovoid, 2 to 2½ in. long; scales small at the base of the cone and unfertile, well-developed in the centre and about ⅞ in. long and ½ in. broad; apophysis brown, rhomboidal, with a transverse ridge near the upper margin; the narrow umbo terminating in a short triangular spreading or reflexed prickle. Seeds, one or two on each scale, brownish, pear-shaped, ⅜ in. long, ¼ in. wide and thick, the testa produced into a narrow rim on each side and a short lacerated wing above, deciduous when the seed falls, incapable of flight, out of the cone.

This remarkable pine occurs wild in the mountains of northern China, where Mayr observed it growing on stony slopes; and it has recently been found by Wilson[2] south-west of Ichang in Hupeh, on precipitous mountains at an altitude of 2000 to 4000 ft. He saw many hundreds of trees scattered for miles, evidently the remains of a considerable forest. Many of these trees were curved at the butt, a few being branched near the ground. It was also collected in northern Shensi, by Père Giraldi,[3] who reports it to be a rare tree 30 to 40 ft. high. It was formerly only known as a tree cultivated around temples, as at Peking, Shanghai, and other localities in central and northern China. It is known to the Chinese as *pai-sung*, "white pine," or *pai-kuo-sung*, "pine with a white bark." *Chiu-lung-sung*,[1] the pine of the nine dragons, cited as the Chinese appellation by Endlicher, is the name given to a single tree of this species, standing in the celebrated temple of Tieh-tai-sze, near Peking; and was so named by the Emperor Chien Lung, who admired its nine tall stems. As usually seen in cultivation in China, the tree has a short trunk, sometimes 12 ft. in girth, dividing at a few feet from the ground into several upright stems, which, in the oldest examples, attain a height of 80 to 100 ft. Fortune[2] gives a good picture illustrating this peculiar habit. Wilson says that the wood is brittle, and only used for fuel. The seeds do not appear to be eaten by the Chinese.

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[1] Mayr states that the bark is dazzling whitish-blue on the sunny side of the tree and greenish-white on the shady side. The name "lace-bark pine" occasionally given to the species is inappropriate.

[2] *Gard. Chron.* xli. 422 (1907).

[3] Note in Botanical Museum at Florence.

*P. Bungeana* was discovered at Peking by Dr. A. Bunge in 1831, and Zuccarini's description was based upon his specimens. Fortune introduced this pine into cultivation in England in 1846; and young plants reared from seed sent by him were growing in 1857 in Glendinning's nursery, Turnham Green.[3] Murray reported in 1863 that specimens about 5 ft. high had withstood without injury the severe winter of 1860. Simon[4] sent young plants to Paris from Peking in 1862.

No trees in cultivation in Europe are as yet old enough to show the beautiful white bark which renders this pine so remarkable at Peking. As a small tree, however, it is fast in growth, ornamental and distinct in habit owing to its vivid green foliage, and is worthy of a place in all collections. The largest specimen known to us is growing at Pampisford, Cambridge, and is about 30 ft. high, dividing into four slender stems near the ground; but it has been retarded in growth by the crowding of other trees. At Kew, where there are several very healthy specimens, which have produced cones for several years, the tree either assumes an erect pyramidal habit or is rounded and bushy in appearance. The largest tree is 25 ft. high and 23 in. in girth at three feet from the ground. Small trees bearing cones also exist at Flitwick, Highnam, and Tregrehan.

At Messrs. Simon-Louis' nursery[5] near Metz, it grows well on calcareous soil and ripened seed when only 12 ft. high. Mayr says that it is perfectly hardy at Grafrath, near Munich, where the winters are very severe.

It is very hardy in eastern Massachusetts, where, though it still retains a bushy habit, cones are produced in abundance. The largest specimen in the United States is growing in Mr. Josiah Hoopes' pinetum at West Chester, Pennsylvania.[6]

(A. H.)

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[1] Cf. Hance, in *Journ. Bot.* xi. 91 (1873).

[2] *Yedo and Peking*, 377, 378 (1863). Cf. *Gard. Chron.* 1863, p. 776.

[3] *Gard. Chron.* 1857, p. 216. Fortune received a further consignment of seed from Peking in 1864, according to *Gard. Chron.* 1864, p. 197.

[4] *Bull. Soc. d'Acclim.* 1863, p. 281.

[5] Beissner, in *Mitt. deut. dendr. Ges.* 1905, p. 35.

[6] *Garden and Forest*, vi. 458 (1893) and x. 470 (1897).

## PINUS GERARDIANA, Gerard's Pine

*Pinus Gerardiana*, Wallich, *ex* Lambert, *Genus Pinus*, ii. 145, t. 79 (1832); Loudon,[1] *Arb. et Frut. Brit.* iv. 2254 (1838); Royle, *Illust. Him. Plants*, 353, t. 85, f. 2 (1839); Forbes, *Pinetum Woburnense*, 53, t. 19 (1839); Cleghorn, in *Journ. Agric. Hort. Soc. India*, xiv. 266, t. 4 (1867); Hooker, *Fl. Brit. India*, v. 652 (1888); Kent, Veitch's *Man. Coniferæ*, 331 (1900); Gamble, *Indian Timbers*, 709 (1902); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 590 (1904); Brandis, *Indian Trees*, 690 (1906); Clinton-Baker, *Illust. Conif.* i. 22 (1909).

*Pinus Gerardi*, Forbes, *Hort. Woburn.* 210 (1833).

A tree, attaining 80 ft. in height and 12 ft. in girth. Bark thin, grey, with scattered brown lenticels, exfoliating in irregular scales, which leave shallow brownish depressions, dotted over with minute holes.

Buds about ⅜ in. long, conic, acuminate; scales appressed and resinous. Young branchlets glabrous, olive green, with prominent pulvini, which are less marked in following years. Leaves in threes, more crowded on the branchlets, duller in colour, and less rigid than those of *P. Bungeana*, straight or slightly curved, 3 to 4 in. long, serrulate, sharp-pointed, marked with stomatic lines on the three surfaces; fibro-vascular bundle undivided, resin-canals marginal; basal sheaths loose, ½ in. long in the first year and completely deciduous in the second year.

Cones, on short scaly peduncles, subterminal, broadly ovoid, variable in size, 4 to 9 in. long, and 3 to 5 in. in diameter; scales 1½ in. long, 1 in. broad, very thick and woody; apophysis triangular, reflexed downwards at nearly a right angle, and ending in a swollen umbo, which is often tipped with a recurved spine. Seed cylindric, ⅝ to 1 in. long, edible; rudiment of the wing present as a narrow deciduous border, remaining on the scale when the seed falls.

Gerard's pine is a native of the western Himalayas, extending eastward to the Niti Pass in Garhwal, and occurring also in the mountains of Baluchistan, northern Afghanistan, Kafiristan, and in the Hariab district. It grows in the inner arid valleys, beyond the reach of the south-west monsoon, never forming dense forests, but occurring in isolated groups on dry steep rocky slopes, especially on granite and slate formations; and ranges between 6000 and 11,000 ft. elevation. Thomson[2] describes it as a compact small tree, with twisted ascending branches and a mottled grey bark, smooth on account of the shedding of the outer layers. Aitchison[3] speaks of it as a very handsome tree, branching more like an oak than a pine, and readily distinguished at a distance by its ashy grey bark, which on close examination consists of patches of all tints from light green to red and brown, due to the peculiar way in which it exfoliates.

According to Gamble, its growth is moderate, about 13 rings per inch of radius. The wood is tough, and used for the hook supporting the passenger's seat on the native rope bridges; but the tree is hardly ever felled as it is very valuable on account of its edible seeds. These are known as *neoza* or *chilghoza*, and are an article of food in Kunawar and other parts of the Himalayas, being largely imported into the plains of India from the hills of the Punjab and Afghanistan. They are oily, with a slight flavour of turpentine, and are eaten roasted at dessert by Europeans. The bark is made into baskets and water buckets.

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[1] Loudon cites as synonymns, *P. Neoza*, Govan, and *P. Chilghoza*, Elphinstone, MS. names without description; and it is doubtful whether they were applied to this species or to *P. longifolia*.

[2] *W. Himalaya and Tibet*, 74.

[3] *Journ. Linn. Soc.* (*Bot.*) xviii. 98 (1881).

The forests of this pine in the Shinghar and Sherghali hills, in north-eastern Baluchistan, and on the adjoining Suliman range and the Maidan plateau, in the North-west Frontier Province of India, have been fully described[1] by Mr. E. P. Stebbing. In his account, which is accompanied by excellent illustrations of fine isolated trees and of scattered woods on the arid slopes of the mountains, Mr. Stebbing says that the species is here seen at its best, trees with fine straight stems 70 to 85 ft. high and 9 to 12 ft. in girth occurring at 7500 to 8500 ft. elevation. The tree grows on what is apparently solid limestone rock, with the scantiest possible supply of water. The tribesmen collect the cones into heaps, and extract the seeds by setting fire to the mass, which causes the cone-scales to gape asunder. Occasionally the tree is tapped for resin.

It was first introduced[2] into England by Lord Auckland, who sent seeds in 1839 to the Horticultural Society, from which plants were raised in the Chiswick Garden.

The tree has never thriven in this country, and is the rarest of all pines in cultivation, the only specimen, exclusive of nursery plants, that we know of in England being a tree, about 15 ft. high, in the Cambridge Botanic Garden, which is probably over thirty years old. In Ireland there is also a single specimen, growing in Lord Ardilaun's grounds at St. Anne's, near Dublin. It measured, in 1903, 25 ft. high and 1 ft. 9 in. in girth, and is pyramidal in habit, with mostly ascending branches. According to Mr. Campbell, the gardener at St. Anne's, it was about 5 ft. high in 1870. Seedlings planted out in 1908 endured the severe winter at Colesborne, with a slight protection of branches, and are now growing slowly.

This species has lived out of doors at Grafrath,[3] near Munich, for nineteen years, but has made little growth in height. Elwes saw a tree in the Botanic Garden at Montpellier, which was about 20 ft. high in January 1910. It had produced cones[4] in the preceding year. (A. H.)

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[1] *Indian Forest Bulletin*, No. 7 (1906); *The Chilgoza Forests of Zhob and the Takht-I-Suliman*, with map and 6 plates (Calcutta, 1906).

[2] Gordon, in Loudon, *Gard. Mag.* xvi. 6 (1848), in giving an account of the introduction, says that all the plants cultivated previously under the name *P. Gerardiana* were in reality *P. longifolia*. Cf. also *Gard. Chron.* 1842, p. 52.

[3] Mayr, *Fremdländ. Wald- u. Parkbäume*, 373 (1906).

[4] Cf. Pardé, in *Bull. Soc. Dend. France*, 1909, pp. 99, 108.

## PINUS BALFOURIANA, Foxtail Pine

*Pinus Balfouriana*, Balfour, *Oregon Exped. Report*, 1, t. 3, f. 1 (1853); Murray, in *Gard. Chron.* v. 332, f. 58 (1876); Sargent, *Silva N. Amer.*, xi. 59, t. 553 (1897), and *Trees N. Amer.* 8 (1905); Kent, Veitch's *Man. Coniferæ*, 313 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 589 (1904).

A tree, usually 30 to 40 ft. high and 6 ft. in girth, rarely attaining 90 ft. in height and 15 ft. in girth. Bark of young trees thin, smooth, and whitish; becoming on old trunks ¾ in. thick, dark red brown, and deeply divided into broad flat scaly ridges. Young branchlets stout, yellowish brown, covered with a minute pubescence. Buds ovoid, acuminate at the apex, about ¼ in. long, with closely appressed brownish scales.

Leaves in fives, densely crowded on the branches, persisting ten or twelve years, nearly appressed together in the clusters, incurved, about 1½ in. long, rigid, sharp-pointed, entire in margin, green and shining on the back, whitened with numerous stomatic lines on the inner surfaces; resin-canals marginal; basal sheath speedily splitting into five segments that become reflexed and form a rosette around the base of the leaf-cluster.

Cones sub-terminal, spreading, sessile, cylindric-conic, 3½ to 5 in. long; scales narrow, elongated; apophysis convex, rhomboidal, transversely keeled, with a minute incurved prickle. Seed pale mottled with violet, ⅓ in. long; wing narrow and oblique at the apex, about 1 in. long.

This species is confined to California, where it is found on Scott Mountain in Siskiyou County, on the mountains at the head of the Sacramento river, on Mount Yolo Bally, in the northern coast range, and in the southern Sierra Nevada, where it attains its largest size. It occurs at elevations of 5000 to 12,000 ft., often forming the timber line,[1] and growing usually on bare rocky slopes and the summits of ridges, in loose granitic soil. At high elevations it occurs in small pure scattered groves or in mixture with *P. albicaulis*, while at lower levels it is associated with *P. monticola*, *P. contorta*, var. *Murrayana*, and other conifers.

The illustration (Plate 277) is from a photograph by Mr. F. R. S. Balfour in the Sierra Nevada mountains, between King's River and Kaweah River, at an elevation of 9000 to 10,000 ft.

This species was discovered in 1852 on Scott Mountain by Jeffrey, who sent a few seeds to the Oregon Association of Edinburgh. It is rare in cultivation, though specimens of small size are to be seen in the botanic gardens of Kew, Edinburgh, and Glasnevin. At Messrs. Little and Ballantyne's nursery, Carlisle, there is a tree about 20 ft. high, which was planted about thirty years ago. It has never produced a single cone; but large numbers of grafts have been propagated from it. At Welbeck, Elwes saw a small tree about 15 ft. high. (A. H.)

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[1] Cf. Pinchot, *U.S. Forest Service*, *Sylvical Leaflet* 26 (1908).

## PINUS ARISTATA, BRISTLE-CONE PINE

*Pinus aristata*, Engelmann, in *Trans. St. Louis Acad.* ii. 205, pl. 5, 6 (1863); Murray, in *Gard. Chron.* iv. 549, fig. 117 (1875); Sargent, *Silva N. Amer.* xi. 63, t. 554 (1897), and *Trees N. Amer.* 9 (1905); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 590 (1904); Clinton-Baker, *Illust. Conif.* i. 5 (1909).

*Pinus Balfouriana*, Balfour, var. *aristata*, Engelmann, in Brewer and Watson, *Bot. California*, ii. 125 (1880); Webster, in *Gard. Chron.* xx. 719, fig. 126 (1896); Kent, Veitch's *Man. Coniferæ*, 314 (1900).

A tree, occasionally attaining 40 to 50 ft. in height, with a short trunk 6 to 9 ft. in girth. Bark, buds, branchlets, and foliage, as in *P. Balfouriana*, though in cultivated specimens the young branchlets of *P. aristata* differ in being covered with a dense reddish brown pubescence; whilst both on wild[1] and cultivated trees of *P. aristata* the leaves are remarkable in being dotted over their outer surface with resinous exudations.

Cones subterminal, spreading, sessile, about 3 in. long, ovoid-conic; scales thin, oblong-cuneate, ¾ to 1 in. long; apophysis rhomboidal, transversely keeled, with a slender incurved brittle prickle, nearly ¼ in. long. Seed light brown, mottled with black, ¼ in. long; wing ⅓ to ½ in. long.

This alpine species is widely distributed from the eastern range of the Rocky Mountains in Colorado westward through the mountains of southern Utah, and central and southern Nevada, southwards in the San Francisco peaks of northern Arizona, and in the mountains of south-eastern California. It grows on rocky or gravelly slopes, forming the timber line in these mountainous regions at 9000 to 12,000 ft. elevation, and producing a soft light wood, which is occasionally used for fuel and in the mines.

This species was discovered[2] in 1861 by Dr. Parry on Pike's Peak in Colorado, and plants raised from seed sent by him to Boston had only attained 18 in. in height at the end of thirty-five years.[3] Seeds were sent[4] in 1863 from Colorado to England, and small trees may be seen in botanic gardens, the specimen at Glasnevin, which has produced cones of late years, being about 15 ft. high. The best specimen we have seen in England is one at Hardwick, near Bury St. Edmunds, which is about 25 ft. high by 2 ft. in girth. It was planted by Sir Joseph Hooker, and bore cones in 1905 when Elwes measured it. There is also one at Aldenham about 20 ft. high which bore cones in 1908. There are also specimens at Ponfield, Herts, and at Ochtertyre,[5] in Perthshire. (A. H.)

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[1] Cf. Engelmann, in *Trans. St. Louis Acad.* ii. 206 (1863).

[2] Murray, in *Gard. Chron.* iv. 549 (1875), says that it was first seen by Captain Gunnison in 1853, near Pike's Peak.

[3] *Garden and Forest*, x. 470 (1897).

[4] *Gard. Chron.* iv. 549 (1875). Gordon, in *Pinetum*, 292 (1875), says that it was first introduced by Mr. Cripps of Tunbridge Wells.

[5] See Masters, in *Gard. Chron.* xxvi. 371 and 382 (1899).

## PINUS MONOPHYLLA, One-leaf Nut Pine

*Pinus monophylla*, Torrey, in Fremont, *Report*, 319, t. 4 (1844); Masters, in *Gard. Chron.* xx. 48, f. 8 (1883), *Ann. Bot.* ii. 126 (1888), and *Journ. Linn. Soc.* (*Bot.*) xxvii. 269, f. 10 (1891), xxxv. 584 (1904); J. D. Hooker, in *Gard. Chron.* xxvi. 136, f. 24 (1886); Sargent, *Silva N. Amer.* xi. 51, t. 551 (1897), and *Trees N. Amer.* 12 (1905); Clinton-Baker, *Illust. Conif.* i. 33 (1909).

*Pinus Fremontiana*, Endlicher, *Syn. Conif.* 183 (1847); Gordon, in *Journ. Hort. Soc.* iv. 293, fig. (1849).

*Pinus cembroides*, Zuccarini, var. *monophylla*, Voss, in *Deut. Gartenrat*, Beilage 123 (1904); Shaw, *Pines of Mexico*, 5 (1909).

A tree usually 25 to 30 ft., occasionally[1] 40 to 50 ft. high, with a short trunk rarely more than 5 ft. in girth. Bark reddish, divided by deep irregular fissures into narrow connected scaly ridges. Young branchlets slender, grey, with scattered minute pubescence. Buds cylindrical, obtuse, ¼ in. long; scales few, closely imbricated, greyish tinged with brown, ovate, apiculate, entire in margin.

Leaves solitary, remotely placed on the branchlets, persistent for four or five years or longer, incurved and directed forwards, rigid, terete, about 1½ in. long, $\frac{1}{16}$ in. in diameter, marked with about twenty stomatic lines, and ending in a sharp cartilaginous point; resin-canals, 3 to 14, marginal. Basal sheath ¼ in. long, its upper part deciduous in the first year, while the lower part persists in the following years as an irregular rosette of reflexed segments. According to Dr. Masters, the solitary leaf is due to the arrested development in the bud of one leaf of a two-leaved cluster. Occasionally the second leaf is fully developed, and two-leaved clusters result. In cultivation adventitious shoots bearing flattish primordial leaves are occasionally produced on the lower branches.

Cones sub-terminal, short-stalked, 1½ to 2 in. long; scales few, with a thick pyramidal non-prickly apophysis and a central umbo. Seed edible, about ⅝ in. long and ¼ in. wide, brownish, oblong, full and rounded at the base, acute at the apex, with a thin brittle shell, and a narrow wing, about ⅓ in. wide, remaining attached to the scale. Cotyledons 7 to 10. The primary flattened leaves, about an inch in length, persist on the seedling till it is about five years old; after which they become shorter, buds forming in their axils and producing the adult leaves.

This species is readily distinguished by its glaucous terete solitary[2] leaves, with reflexed basal sheaths, and its peculiar buds. When two-leaved clusters appear the leaves are semi-terete and entire in margin.[3]

This pine is widely distributed, extending from the western base of the Wasatch mountains in Utah, westward through the mountain ranges of Nevada, to the Sierra Nevada in central California, and southwards to Arizona, and the coast ranges of southern California and of northern Lower California. It grows in a very dry climate, the rainfall varying from 16 in. in the northern part of its area to 5 in. in the southern part, while the temperature is extreme, ranging from a minimum of – 2° Fahr. in the Sierra Nevada to a maximum of 122° Fahr. in the Mojave desert. It occurs in arid situations on foothills, gravelly slopes, and rocky elevations, at elevations of 3800 to 6800 ft. in Utah and Nevada, and 4000 to 9500 ft. in the San Bernardino mountains, where the tree is abundant. It usually grows in mixture with other species, but frequently forms pure open woods over large areas. In Arizona it is associated with *Pinus edulis*, *Juniperus monosperma*, *J. pachyphloea*, and *Cupressus arizonica*. In Utah its chief companion is *Juniperus utahensis*, while in southern California it occurs sparingly in the chaparral formations, together with *J. californica*, oaks, and tree yuccas. Occasionally it grows with *Abies concolor* or with *Pinus Jeffreyi*.

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[1] According to Pinchot, *U.S. Forest Service*, *Sylvical Leaflet* 16 (1908), a few trees have been seen in the Tehachapi mountains, 4 ft. in diameter and nearly 100 ft. in height.

[2] Solitary leaves occasionally occur as a sport in other pines, as in *P. sylvestris*, var. *monophylla*, but such cases present no difficulty, as the buds, leaves, and basal sheaths are entirely different.

[3] Cf. Engelmann, in Rothrock, *Report Geol. Surveys*, vi. *Botany*, 259 (1878).

*P. monophylla* was considered by Newberry[1] to be a depauperate or desert form of *P. edulis*, which has a more easterly distribution. Sir Joseph Hooker, however, was convinced that the two species are distinct, and that two-leaved forms of *P. monophylla* are not identical with *P. edulis*. The latter has dull leaden grey foliage, whereas that of *P. monophylla* is glaucous with a silvery sheen. *P. monophylla* is the stronger plant of the two, and cannot be regarded as depauperate.

This peculiar pine was discovered by Fremont in 1844, and was introduced into Europe by Hartweg[2] in 1848. It is extremely slow in growth, a specimen 5½ in. in diameter from Utah, which was examined by Sargent, showing 113 annual rings. It is occasionally seen in botanic gardens, there being a healthy specimen about 5 ft. high at Cambridge. Hooker, writing in 1886, mentions a tree at Kew, no longer living, which was only 6 ft. high, though it was twenty years old, yet he considered it to be faster in growth than *P. edulis*. The best specimen we know of in England is a tree at Dunburgh House, Beccles, which is about 14 ft. high, and bore a single cone in 1908. Another at Paul's Nursery, Cheshunt, was 13 ft. high in 1909. Seedlings received from Kew have proved hardy at Colesborne, though they grow very slowly. Elwes saw a specimen, about 20 ft. high, in the Botanic Garden at Montpellier, which bore young and old cones with good seed in 1910.

The seeds are the staple food of the Indians in Nevada, and are highly esteemed by white people, who eat them roasted. The timber is used for firewood, and is also largely employed in the mines. (A. H.)

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[1] *Bull. Torrey Bot. Club*, xiii. 183 (1886). M. E. Jones, in *Zoe*, iii. 307 (1893), states that the leaves of *P. monophylla* are much more robust and vigorous than those of *P. edulis*.

[2] *Journ. Hort. Soc.* iii. 226 (1848).

## PINUS EDULIS

*Pinus edulis*, Engelmann, in Wislizenus, *Tour Mexico, Bot. App.* 88 (1848), and in Rothrock, *Geol. Surveys*, vi. *Botany*, 260 (1878); Sargent, *Silva N. Amer.* xi. 55, t. 552 (1897), and *Trees N. Amer.* 11 (1905); Masters, in *Gard. Chron.* xii. 563, fig. 86 (1892), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 587, fig. 2 (1904); Clinton-Baker, *Illust. Conif.* i. 19 (1909).

*Pinus monophylla*, Torrey, var. *edulis*, M. E. Jones, in *Zoe*, ii. 251 (1891).

*Pinus cembroides*, Zuccarini, var. *edulis*, Voss, in *Deut. Gartenrat*, Beilage 123 (1904); Shaw, *Pines of Mexico*, 6 (1909).

A tree, usually small in size, rarely attaining 40 ft. in height and 8 ft. in girth, with a short, often divided trunk. Bark ½ to ¾ in. thick, irregularly divided into scaly ridges. Young branchlets stouter than in *P. cembroides*, grey, glabrous. Buds ovoid, acute, ⅓ in. long, with brownish, densely imbricated, apiculate scales.

Leaves in pairs, with occasional three-leaved clusters, persistent three to five years, not so crowded on the branchlets as those of *P. cembroides*, appressed together in each cluster, ¾ to 1½ in. long, rigid, stout, curved, sharp-pointed, entire in margin, with numerous stomatic lines on both surfaces; resin-canals marginal; basal sheath as in *P. cembroides*.

Cones similar to those of *P. cembroides*, but usually smaller, with the pyramidate apophysis of each scale more elevated than in that species, and the slightly deflexed umbo armed with a minute prickle, often obscured by resin. Seed smaller and lighter in colour than in *P. cembroides*; shell thin and brittle; wing rudimentary, about ⅛ in. in length.

This species is widely distributed along the eastern foothills of the Rocky Mountains, from Colorado through New Mexico to western Texas, and extends westward through south-western Wyoming to Utah, northern and central Arizona, and southward over the mountains of northern Mexico. Associated with junipers (*J. monosperma* and *J. pachyphloea*), it forms extensive open forests between 5000 and 7700 ft. elevation, rarely ascending as a stunted shrub to 9000 ft. F. J. Phillips[1] states that in southern Colorado, Arizona, and New Mexico it is a tree of great economic and silvicultural importance. It succeeds in arid localities, where the average annual precipitation is less than 13 in. Its wood is much used for fuel; and to a lesser extent for fencing, railway sleepers, and mining timber. The seeds are an important article of food among Indians and Mexicans, and are sold in the markets of Colorado and New Mexico.

This species was described by Engelmann from specimens collected in 1846 by Dr. Wislizenus in New Mexico; and was introduced into cultivation[2] at Kew many years ago, but is now only represented there by one or two small plants. We have not seen it elsewhere. (A. H.)

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[1] In *Bot. Gaz.* xlviii. 216-223 (1909).

[2] Cf. J. D. Hooker, in *Gard. Chron.* xxvi. 136 (1886).

## PINUS CEMBROIDES

*Pinus cembroides*, Zuccarini, in *Abhand. Akad. München*, i. 392 (1832); Sargent, *Silva N. Amer.* xi. 47, t. 550 (1897), and *Trees N. Amer.* 10 (1905); Kent, Veitch's *Man. Coniferæ*, 321 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 586 (1904); Clinton-Baker, *Illust. Conif.* i. 15 (1909); Shaw, *Pines of Mexico*, 5 (1909).

*Pinus Llaveana*, Schlechtendal, in *Linnæa*, xii. 488 (1838).

*Pinus osteosperma*, Engelmann, in Wislizenus, *Tour Mexico*, *Bot. App.* 89 (1848).

A tree, usually 20 ft. high with a short trunk rarely more than a foot in diameter, occasionally attaining in sheltered cañons 50 or 60 ft. in height. Bark about ½ in. thick, slightly fissured, and separating on the surface into thin reddish brown scales. Young branchlets slender, glaucous, minutely pubescent or glabrous. Buds spindle-shaped, acute at the apex, brownish, about ¼ in. long, with densely imbricated scales, free at their subulate points.

Leaves in threes, with occasional two-leaved clusters, densely crowded on the branchlets, persistent for three or four years, nearly appressed together in each cluster, 1½ to 2 in. long, curved, sharp-pointed, entire in margin, conspicuously whitened with stomatic bands on the inner surface, green with two or three stomatic lines on the outer surface; resin-canals marginal; basal sheath $\frac{3}{10}$ in. long, the basal segments speedily becoming reflexed and forming a rosette around the bases of the leaf cluster.

Cones subterminal, nearly sessile, almost globose, 1½ to 2 in. in diameter; scales few and only well-developed and fertile in the middle of the cone, about an inch long; apophysis pyramidal, with a sharp transverse keel, and a depressed brown oval unarmed dorsal umbo. Seed, rather more than ½ in. long; ovoid, irregularly conical or obscurely three-angled; blackish on the lower surface, dark brown on the upper surface; wing rudimentary, about $\frac{1}{32}$ in. in length, remaining attached to the scale when the seed falls.

This species is widely distributed through northern Mexico, where it often forms scattered open forests of considerable extent on the lower slopes of the mountain ranges, though it occasionally ascends to 10,000 ft. The seeds are sold in the markets of Mexican cities, forming an important article of food, and are eaten roasted or are ground into flour. This pine also occurs in the mountains of central and southern Arizona, usually above elevations of 6500 ft., and was found by Brandegee, forming a forest, on the top of the Sierra de Laguna in Lower California.

This species[1] was introduced into England in 1830, when the Horticultural Society obtained a plant from Mr. Otto of Berlin; and seeds were subsequently sent from Mexico by Hartweg in 1839. The largest specimen is at Highnam, and measured, in 1908, 33 ft. by 2 ft. 8 in. Another at Glasnevin, which is about 25 ft. high, divides into two stems at 8 ft. from the ground, and bears cones freely. There are smaller trees at Kew and Menabilly. (A. H.)

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[1] Loudon, in *Arb. et Frut. Brit.* iv. 2267 (1838), gives an incorrect figure of the cone of *P. Llaveana*, a synonym of the species; but in his *Trees and Shrubs*, 993 (1842), cones of *P. cembroides*, both from Otto of Berlin and from Hartweg, are correctly figured; and the tree in the Horticultural Society's Garden, which was 4½ ft. high in 1837, appears to have been undoubtedly this species. Cf. also Loudon, *Gard. Mag.* xv. 128 (1839).

## PINUS PARRYANA

*Pinus Parryana*, Engelmann, in *Amer. Journ. Science*, xxxiv. 332, note (1862) (not Gordon), and in Brewer and Watson, *Bot. California*, 124 (1880); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 586, fig. 1 (1904); Sargent, in *Bot. Gaz.* xliv. 227 (1907); Clinton-Baker, *Illust. Conif.* i. 39 (1909).

*Pinus quadrifolia*, Parry, *ex* Parlatore in DC., *Prod.* xvi. 2, p. 402 (1868); Sudworth, *U.S. Forestry Bull.* No. 14, p. 17 (1897); Sargent, *Silva N. Amer.* xi. 43, t. 549 (1897), and *Trees N. Amer.* 10 (1905).

*Pinus cembroides*, Zuccarini, var. *Parryana*, Voss, in *Deut. Gartenrat*, Beilage 123 (1904); Shaw, *Pines of Mexico*, 6 (1909).

A tree, usually 20 to 30, occasionally 40 ft. in height, and rarely exceeding 5 ft. in girth. Bark, buds, and branchlets similar to *P. monophylla.*

Leaves in fours, with occasional five-leaved clusters, remotely placed on the branchlets, appressed together in the clusters, persistent three or four years, 1¼ to 1½ in. long, incurved, rigid, sharp-pointed, entire in margin, with white stomatic bands on the inner surfaces; resin-canals marginal; basal sheath as in *P. monophylla.*

Cones and seeds similar to those of *P. monophylla.*

This species, which is scarcely distinguishable, except in the leaves, from *P. monophylla*, is restricted in its distribution to the Santa Rosa[1] and Toro mountains in the San Jacinto range of southern California, and to Lower California, where it grows as far south as the foothills of the San Pedro Martir mountain.[2] It was discovered in 1850 by Dr. Parry, 60 miles south-east of San Diego, California, at 2000 ft. altitude.

The four-leaved *piñon* requires a moister climate[3] than *P. monophylla*, thriving where the annual rainfall is 15 to 25 in. and growing at elevations between 2500 and 8000 ft. It usually occurs in open forests, mixed with other species, as *P. monophylla*, oaks, and juniper.

It appears to be exceedingly rare in cultivation, the only specimen which I have seen being a small tree at Grignon in France. Dr. Masters appears to have seen young plants, as he states that the species is remarkable for the abundance and long duration of the primary needles, which are of a beautiful bluish colour.

(A. H.)

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[1] It was found, according to S. B. Parish, in *Erythea*, vii. 89 (1899), by H. M. Hill on the desert slope of Santa Rosa mountain, where it exists in considerable quantity at about 5000 ft. altitude. It does not exist on the San Jacinto peak. H. M. Hill, in *Univ. Calif. Publications, Bot.* i. 20 (1902), reports it to be growing sparingly in the neighbourhood of Mount Toro.

[2] Cf. Brandegee, in *Zoe*, iv. 210 (1893).

[3] Cf. Pinchot, *U.S. Forest Service, Sylvical Leaflet* 17 (1908).

## PINUS MONTEZUMÆ, MONTEZUMA PINE

*Pinus Montezumæ*,[1] Lambert, *Gen. Pin.* i. 39, t. 22 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2272 (1838); Kent, Veitch's *Man. Conif.* 345 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 600 (1904); Clinton-Baker, *Illustrations of Conifers*, i. 35 (1909); Shaw, *Pines of Mexico*, 21, t. xiv. (1909).

*Pinus Devoniana*, Lindley, in *Bot. Reg.* xxv. *Misc.* 62 (1839).

*Pinus Russelliana*,[2] Lindley, in *Bot. Reg.* xxv. *Misc.* 63 (1839).

*Pinus macrophylla*, Lindley, in *Bot. Reg.* xxv. *Misc.* 63 (1839).

*Pinus filifolia*,[2] Lindley, in *Bot. Reg.* xxvi. *Misc.* 61 (1840).

*Pinus Grenvilleæ*, Gordon, in *Journ. Hort. Soc.* ii. 77 (1847); Masters, in *Gard. Chron.* xv. 112, fig. 22 (1881).

*Pinus Gordoniana*, Hartweg, in *Journ. Hort. Soc.* ii. 79 (1847).

*Pinus Wincesteriana*, Gordon, in *Journ. Hort. Soc.* ii. 158 (1847).

*Pinus occidentalis*, Humboldt, Bonpland, and Kunth, *Nov. Gen. et Sp.* ii. 4 (1817) (not Swartz).

A tree, attaining in Mexico 70 ft. in height. Bark brownish red, irregularly divided into scaly plates. Young branchlets stout, glabrous, reddish brown; their decurrent pulvini prominent, keeled, and persistent, with the epidermis peeling off in the second or third year, leaving a greyish-coloured surface. Buds ovoid, pointed, about an inch long, reddish brown, scarcely resinous; scales ending in long acuminate points, with their bases interlaced by whitish marginal fimbriæ. The brown linear-lanceolate scale-leaves with white fimbriæ, persist during the first year.

Leaves in fives, persistent three years, 4 to 18 in. long, crowded on the branchlets, spreading, serrulate, with stomatic lines on the three surfaces, ending in a cartilaginous point; resin-canals median; basal sheath 1¼ to 2 in. long, persistent. Flower buds, with the staminate catkins concealed, and not apparent as swellings externally.

Cones, in the first year, subterminal, single or in clusters of 2 to 5, stalked, pale or deep brown, blue, or dull black; scales armed with usually reflexed prickles. Mature cones 2½ to 10 in. long, subsessile or stalked, spreading or deflexed, nearly cylindrical or ovoid-conic and tapering, often curved, opening when ripe, and falling soon afterwards, when their stalks and a few basal scales often remain on the branch; scales variable in size; apophyses flat, pyramidal, tumid, or slightly protuberant and reflexed, dull yellowish, reddish brown, dark brown, or nearly black, prickles usually obsolete. Seed oval, brownish mottled with black, ¼ in. long; wing narrow, an inch or more in length.

This species is very variable, both in the length of the leaves and in the size of the cones; and is met with, according to Shaw, at all altitudes[3] in Mexico, except in the lowlands of the coast, and below 3000 ft. in the interior, where the climate is tropical. At 9000 ft. and below, this pine mingles with the oaks in the more fertile and moister soil; while above, and more especially on the summit ridges, it sometimes forms dense forests. Large trees 3 to 4 ft. in diameter occur above Oaxaca.[1] *P. Montezumæ* was discovered near the city of Mexico in 1803 by Humboldt and Bonpland, who mistook it for the West Indian *P. occidentalis*; and it was first recognised and described by Lambert in 1832.

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[1] Roezl's Catalogue of 82 new Mexican species, published in 1857, does not contain, according to Shaw, a single new species. They represent six or seven pines, all of which had been previously described. Roezl's list is given by Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 648, and will not be further noticed by us.

[2] The type specimens of the cones of these two species are preserved in the Botanical Museum, Cambridge. *P. filifolia* is labelled Guatemala.

[3] Gadow, in *Journ. Linn. Soc.* (*Bot.*) xxxviii. 432 (1909), makes the timber line in southern Mexico 13,500 to 14,000 ft., where there are only a few scattered trees of *P. Montezumæ*.

### VARIETIES

The following account of the principal forms of this species in the wild state is taken from Shaw, who has made a special study of the Mexican pines:—

1. The typical form is sub-tropical, inhabiting the slopes and table-lands between 3000 and 6000 ft. It is characterised by long leaves, with basal sheaths exceeding an inch in length; by large non-resinous buds; and by cones 6 to 10 in. long, brown in colour, the apophyses of the scales being elevated, with usually prominent brownish umbos.

2. Var. *Lindleyi*, Loudon, *Encyc. Trees*, 1004, fig. 1882 (1842); Shaw, *Pines of Mexico*, 22, t. xv. (1909).

*Pinus Lindleyana*, Gordon, *Pinetum*, 229 (1858).

Leaves often very slender, and drooping like those of *P. pseudostrobus*, 6 to 10 in. long; cones 4 to 6 in. long; apophyses small and numerous, flat or slightly pyramidal, often rectangular and very like var. *Hartwegii*, but pale brown and not black in colour.

This variety occurs at altitudes with a temperate climate.

3. Var. *rudis*, Shaw, *Pines of Mexico*, 22, t. xvi. figs. 1-5, 8 (1909).

*Pinus Montezumæ*, Gordon, in *Journ. Hort. Soc.* i. 234 (1846); Masters, in *Gard. Chron.* viii. 466, figs. 91-94 (1890), xv. 273, figs. 29-32 (1894), and xxv. 146, fig. 53 (1899).
*Pinus rudis*, Endlicher, *Syn. Conif.* 151 (1847).
*Pinus Ehrenbergii*, Endlicher, *Syn. Conif.* 151 (1847).
*Pinus Hartwegii*, Parlatore, in DC., *Prod.* xvi. pt. 2, p. 399 (1868) (in part).

Leaves 4 to 6 in. long. Cones in the first year blue or bluish-black; when mature, 2½ to 4 in. long, dull, sometimes shining brown.

This variety, which usually has leaves in fives, though there are occasionally six or seven in a cluster, grows at altitudes with a warm temperate climate, and is connected by intermediate forms with var. *Lindleyi*.

4. Var. *Hartwegii*, Engelmann, in *Trans. St. Louis Acad. Sc.* iv. 177, 181 (1880); Shaw, *Pines of Mexico*, 23, t. xvii. figs. 6, 7 (1909).

*Pinus Hartwegii*, Lindley, in *Bot. Reg.* xxv. *Misc.* 62 (1839); Loudon, *Encycl. Trees*, 1000, fig. 1875 (1842); Kent, Veitch's *Man. Conif.* 348 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 600 (1904); Clinton-Baker, *Illust. Conif.* i. 24 (1909).
*Pinus Donnell-Smithii*, Masters, in *Bot. Gaz.* xvi. 199 (1891), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 600 (1904); Smith, in *Bot. Gaz.* xix. 13, t. 2 (1894).

Leaves 3 to 6 in. long, often in threes and fours, as well as in fives. Cones similar to those of var. *rudis*, but very dark brown, or almost black in colour when mature.

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[1] Cf. *Garden and Forest*, ix. 102 (1896).

This variety occurs in colder regions and at higher altitudes than any other Mexican pine, forming the timber line and descending to some distance below it. Mr. Godman wrote to Dr. Masters that this pine forms a complete belt around the Volcan de Fuego, commencing at about 10,000 ft., and on the Volcan d'Agua ascends to the summit. The mixed forest of Cheirostemon and other trees ceases abruptly at about 10,000 ft., and one steps suddenly out of it into the more open pine belt, where the only undergrowth is a coarse grass.

### CULTIVATION

Both the typical form and the varieties were introduced by Hartweg in 1839, when numerous plants were raised in the garden of the London Horticultural Society.

As seen in cultivation, this species is readily distinguishable into two principal forms; one, probably identical with the type, as defined by Shaw, and characterised by long leaves, averaging 9 in. in length, with basal sheaths 1¼ to 2 in. long, and large, scarcely resinous buds. In the only specimen which we have seen in fruit, a tree cultivated at Bicton[1] as *P. Russelliana*, the cones produced are 5 in. long, and 2¼ in. in diameter, with large shining pale brown elevated apophyses, terminating in a dark coloured projecting umbo. It was 60 ft. by 6 ft. 9 in. when measured by Elwes in 1906. The gardener in May 1909 reported that this tree was nearly dead, though it was still bearing a few old cones.

The typical form is well represented at Pencarrow, where two trees planted in 1849 measured in 1907, 50 ft. by 9 ft., and 49 ft. by 5 ft. These differ strikingly in habit, but show no differences in botanical characters. Elwes saw a fine spreading tree at Endsleigh in August 1906 which measured about 50 ft. by 9½ ft. in girth. There are good specimens at Tregothnan, Heligan, and other places in Cornwall.

At Eastnor Castle, a small spreading tree, 26 ft. high, seems healthy.

At Grayswood, Haslemere, a tree planted in 1881 had attained 25 ft. by 2 ft. 10 in. in 1906, and did not suffer in the winter of 1895.

In Ireland this succeeds well, as at Woodstock, Kilkenny, where a tree was 48 ft. by 6 ft. in 1904; and at Old Connaught House, near Bray, where a tree planted in 1869 was 34 ft. by 2 ft. 9 in. in 1904.

The other form, which is probably var. *Hartwegii*, produces cones freely, which are ovoid-conic and tapering to an acute apex, 3 to 3½ in. long, with numerous small scales, with flat apophyses, and slightly raised dark brown umbos. The leaves, often in fours as well as in fives, are 5 to 6 in. long, with basal sheaths not exceeding an inch in length. The buds are slender, ½ to ¾ in. long, with usually resinous appressed scales.

Var. *Hartwegii* is much the hardiest form; and we have found specimens, even in the eastern counties, as at Pampisford, near Cambridge, where a tree in a sheltered position is 28 ft. by 1 ft. 10 in. At Bayfordbury, Herts, a tree planted in 1845 died in 1854; another specimen planted in 1875 is now 20 ft. high and 2 ft. 3 in. in girth. At Flitwick Manor, Bedford, a tree measured in 1908, 34 ft. by 2 ft. 7 in. Much finer trees, most of them producing cones, exist farther west, as at Westonbirt, where a tree planted in 1869 measured in 1909, 45 ft. high, and looked very vigorous. At Bicton there are two good specimens, 74 ft. by 5 ft. 3 in. and 46 ft. by 4 ft. 4 in. At Eastnor Castle, a fine tree was 55 ft. by 4 ft. 8 in. in 1909. At Bury Hill, Dorking, a tree, which R. Barclay, Esq., informs us was planted in 1847, is 36 ft. high and 3 ft. 8 in. in girth at 4 ft. from the ground. At Strete Raleigh, Exeter, H. M. Imbert Terry, Esq., reports a tree 52 ft. by 5 ft. 11 in., from which he raised about fifty seedlings in the spring of 1909. It was planted about 1855. At Pencarrow a tree measured 44 ft. by 3 ft. in 1906. At Escot, Devonshire, the seat of Sir John Kennaway, Elwes measured a tree 65 ft. by 7 ft. in 1909, with a clean bole about 35 ft. long, which is the finest of its kind that he has seen. We have also received specimens of this variety from Wadebridge and Luscombe Castle, Dawlish.

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[1] The Hon. Mark Rolle wrote to the Director at Kew that this tree produced cones for the first time in 1899.

A third form, represented by a tree at Menabilly,[1] and another at Fota, has longer leaves and longer cones than in var. *Hartwegii*, though the latter are similar in every respect except in size, and may be referred in all probability to var. *rudis*. The tree at Fota (Plate 278) is a fine one, and measured 50 ft. by 7 ft. 3 in. in 1908, the branches covering an area 52 paces around. Lord Barrymore informs us that it was planted in 1878. (A. H.)

## PINUS PSEUDOSTROBUS

*Pinus pseudostrobus*, Lindley, in *Bot. Reg.* xxv. *Misc.* 63 (1839); Loudon, *Encycl. Trees*, 1008, figs. 1887, 1888 (1842); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 605 (1904); Shaw, *Pines of Mexico*, 19, t. xii. (1909).

*Pinus orizabæ*, Gordon, in *Journ. Hort. Soc.* i. 237 (1846).

A tree attaining 100 ft. in height and 6 ft. in diameter. Bark of branches and young trees smooth; in old trees very rough at the base. Branchlets slender, glabrous, very glaucous; the decurrent bases of the leaves persistent, conspicuous at first, but ultimately becoming merged in the smooth bark of the older branchlets, on which they are visible as transverse lines. Buds and leaves, the latter 6 to 12 in. long, similar to those of *P. Montezumæ*, but usually more slender.

Cones sub-terminal, described by Shaw as ovate or oblong, 3 to 5½ in. long, nearly symmetrical or oblique, opening when ripe and falling soon afterwards, the peduncle and a few basal scales usually remaining persistent on the branch; apophysis variable, flat or protuberant.

1. Var. *apulcensis*, Shaw, *Pines of Mexico*, 19, t. xii. (1909).

*Pinus apulcensis*, Lindley, in *Bot. Reg.* xxv. *Misc.* 63 (1839); Loudon, *Encycl. Trees*, 1014, figs. 1899, 1900 (1842).

Differs in the prolongation of the apophyses of the scales of the cone. It grows in Mexico in company with the type, and is connected with it by intermediate forms.

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[1] Figured in *Gard. Chron.*, *loc. cit.* It bore cones in 1899, when it was 20 ft. high, but Mr. Rashleigh said that no perfect seed was produced.

2. Var. *tenuifolia*, Shaw, *Pines of Mexico*, 20, t. xiii. (1909).

*Pinus tenuifolia*, Bentham, *Pl. Hartw.* 92 (1842).

Cones ovate or long-ovate; basal scales and peduncles persistent on the branch. Hypoderm of the leaves extending from the epiderm to the endoderm, forming partitions across the green tissue.[1] Abundant at altitudes with a sub-tropical climate in the western and south-western states of Mexico, and extending southward to north-western Nicaragua.

According to Shaw, *P. pseudostrobus* occurs in Mexico at altitudes between 6000 and 10,000 ft., where the climate is temperate, with warm days and cool nights. This zone includes the tableland and the slope immediately above it.

This species, and var. *apulcensis*, were discovered in 1839 by Hartweg, who sent home in the same year cones and seeds, from which, according to Loudon, numerous plants were raised. Nearly all these have died, as the tree is evidently only suitable for cultivation in districts where the climate is mild, like Cornwall and southern Ireland. The only specimens which we have found, are two trees in Cornwall. One at Pencarrow, was obtained from Knight and Perry in 1849; and measured, in 1906, 47 ft. high, and 5 ft. 8 in. in girth. Mr. Bartlett kindly sent us photographs of this tree, and of several trees of *P. Montezumæ*, and the difference in the bark of the two species is remarkable. That of *P. pseudostrobus* is smooth, and only slightly furrowed; whereas in *P. Montezumæ*, the bark is very rough and scaly. Another, growing at Tregothnan, was measured by Mr. A. B. Jackson as 50 ft. by 6 ft. in 1909. Neither tree has produced cones.

(A. H.)

## PINUS TORREYANA

*Pinus Torreyana*, Parry, *ex* Torrey, in Emory, *Bot. Mex. Bound.* 210, tt. 58, 59 (1858); Sargent, *Silva N. Amer.* xi. 71, tt. 557, 558 (1897), and *Trees N. Amer.* 34 (1905); Kent, Veitch's *Man. Conif.* 348 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 602 (1904); Clinton-Baker, *Illust. Conif.* i. 56 (1909).

*Pinus lophosperma*, Lindley, in *Gard. Chron.* 1860, p. 46.

A tree, attaining 60 ft. in height and 8 ft. in girth, but usually considerably smaller. Bark an inch in thickness, deeply divided irregularly into broad flat scaly ridges. Young branchlets glabrous, glaucous; become dull grey in the second year. Buds cylindric-conic, ½ in. long; scales pale brown, interlaced by their marginal white fimbriæ, and with appressed points.

Leaves[2] in fives, persistent two years, dark green, 7 to 13 in. long, $\frac{1}{12}$ in.

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[1] A very fine tree near the hotel at Bussaco, Portugal, which Elwes measured in April 1909, 90 ft. in height and 9 ft. in girth, is probably this variety; but in the absence of cones, the identification is uncertain.

[2] On young plants the leaves are frequently in clusters of three and four.

wide, rigid, marked on three sides by stomatic lines, serrulate, ending in a sharp cartilaginous point; resin-canals median; basal sheath an inch long.

Cones sub-terminal, spreading or deflexed, on long stalks, broadly ovoid, 4 to 6 in. long; scales thick, 2 in. long, 1¼ in. wide, shining brown; apophysis rhomboidal, transversely ridged, with an elevated pyramidal four-sided acute umbo, with or without a minute prickle. Seed oval, ¾ to 1 in. long, dull brown and mottled below, pale brown above; surrounded by a dark brown wing, thickened at the upper margin of the seed, and extending beyond its apex about ½ in.

Masters describes the seedlings, raised at Kew, as robust, with a long tapering radicle, stout cylindrical stem, and twelve linear cotyledons, succeeded by primary leaves, elliptic in section.

This species is more circumscribed in its distribution than any other pine. It occurs in two localities, the main body growing in a narrow belt, about eight miles long, on the Californian coast, near the mouth of the Soledad river, north of San Diego, nowhere penetrating inland more than a mile and a half. This grove was discovered by Dr. Parry in 1850, whose attention was directed to this pine by J. L. Le Conte, the distinguished entomologist, who was then collecting at San Diego. A single grove, of about one hundred trees, with numerous seedlings, discovered by Brandegee in 1888, also grows on the eastern end of Santa Rosa island,[1] on a bluff 500 ft. above the level of the sea. These trees average 30 ft. high.

Miss Sessions of San Diego, who sends us an account of this pine, which was fast disappearing, states that of late steps have been taken, which will ensure its preservation. It grows on the sea-coast, buffeted, twisted, and often prostrated by the ocean winds, and averages 30 to 40 ft. in height. At Del Mar, 22 miles north of San Diego, the South Coast Land Company has bought a large tract, including all the sandstone cliffs and cañons leading down to the sea, where the Torrey pines grow in this neighbourhood. The Company has built an hotel, and is protecting all the old pines, and preserving the natural seedlings, and planting in addition. The Torrey Pine Park, which is public property, is on a high and exposed point, south-west of Del Mar; and here all the trees are carefully guarded.

William Lobb sent specimens, with cones and seed, to Low's nursery at Clapton in 1860, which were described by Lindley[2] as *P. lophosperma*. Plants were reported[3] to be growing in the Edinburgh Botanic Garden in 1868. It has, however, proved tender there and at Kew, and seems unsuited for cultivation except in warm districts like Cornwall and southern Ireland. The only specimen now living, that we are acquainted with, was planted at Bayfordbury in 1908. Mayr, however, states[4] that he raised seedlings in Japan, which bore a temperature of − 12° Cent. without injury. There are three fairly large trees of this species in the Public Gardens, Christchurch, New Zealand, which bear a few cones.[5] (A. H.)

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[1] *Garden and Forest*, x. 232 (1897).

[2] *Gard. Chron.* 1860, p. 46.

[3] *Gard. Chron.* 1868, p. 237.

[4] *Wald. Nordamer.* 276 (1890).

[5] T. W. Adams, *Genus Pinus*, 10, paper read at Phil. Inst., Canterbury, N.Z., 7th August 1907.

## PINUS COULTERI, Coulter's Pine.

*Pinus Coulteri*, Don, in *Trans. Linn. Soc.* xvii. 440 (1836); Loudon, *Arb. et Frut. Brit.* iv. 2250 (1838); Lawson, *Pinet. Brit.* i. 23 (1884); Masters, in *Gard. Chron.* xxiii. 415, figs. 73, 74 (1885), iv. 764, fig. 109 (1888), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 597 (1904); Sargent, *Silva N. Amer.* xi. 99, tt. 571, 572 (1897), and *Trees N. Amer.* 24 (1905); Kent, Veitch's *Man. Coniferæ*, 325 (1900); Clinton-Baker, *Illust. Conif.* i. 17 (1909).

*Pinus macrocarpa*, Lindley, in *Bot. Reg.* xxvi. app. 61 (1840).

A tree, attaining in America 80 ft. in height and 12 ft. in girth. Bark about 2 in. thick, dark brown, deeply divided into broad rounded connected scaly ridges. Young branchlets stout, glabrous, glaucous, with very prominent pulvini. Buds ovoid, acuminate or cuspidate, very large, 1 to 1½ in. long, and ¾ in. thick; scales appressed, coated with resin, light brown, with white fimbriæ on their margins.

Leaves in threes, spreading, persistent for three or four years, 8 to 12 in. long, $\frac{1}{16}$ to $\frac{1}{12}$ in. wide, rigid, curved, twisted, serrulate, marked with numerous stomatic lines on the three surfaces, ending in a long sharp cartilaginous point; resin-canals median; basal sheath 1½ in. long.

Cones[1] lateral, on short stout stalks, pendulous, ovoid, 10 to 14 in. long, and 4 to 5 in. in diameter, yellowish brown; scales thick, 2½ in. long, 1½ in. broad; apophyses obliquely pyramidal, terminating in flattened elongated umbos, straight or curved, and armed with flattened incurved resinous spines. Seeds, on deep depressions on the scales, oval, compressed, ½ in. long, dark brown or blackish, encircled by the wings which, very narrow and rim-like on the sides, expand above, and are oblique, brown, and about an inch in length. Cotyledons, 10 to 14.

The cones open in autumn in California, remaining, after the seeds escape, on the branches for several years. Occasionally the cones are shorter and thicker than usual, with short spurs, and then resemble those of *P. Sabiniana*; but they may always be distinguished by the long-winged seeds, which leave long depressions on the inner surface of the scales.

This species is scattered singly or in small groves through coniferous forests on the dry slopes and ridges of the coast ranges of California, from Mount Diablo and the Santa Lucia mountains southwards to the Cuyamaca mountains, at elevations between 3000 and 6000 ft. It is most abundant on the San Bernardino and San Jacinto[2] ranges, at 5000 ft. altitude. It is usually known as the big-cone pine, from the size of the cones, which often weigh three or four pounds. The seeds were formerly gathered in large quantities and eaten by the Indians. *P. Coulteri* differs much in habit[1] from *P. Sabiniana*, always having a straight undivided stem, with wide spreading branches, forming a broad pyramid of foliage.

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[1] According to Lawson, *Pinet. Brit.* i. 24 (1884), a tree, eighteen years old, in the Jardin des Plantes, Paris, produced two cones in 1852.

[2] H. M. Hall, in *Univ. Calif. Publications, Botany*, i. 20, 53 (1902), says it is commonly met with on the south and west sides of the San Jacinto mountain, where it forms small groves and narrow strips along the lower edge of the belt of *P. ponderosa*. It is also found scattered among the other pines up to 6500 to 7500 ft. on south slopes, but does not occur on the sides of the mountain facing the Colorado desert. The seeds have a strong oily taste, and are not gathered by the Saboba and Santa Rosa Indians, those of *P. monophylla* and *P. Parryana* being much preferred.

This species was discovered by Coulter[2] in the Santa Lucia mountains in 1832; and in the same year Douglas sent home specimens with seeds, from which plants were raised in the garden of the Horticultural Society. Young plants were raised[3] at Kew in 1840 from the seed of a cone, the origin of which is not stated. A further consignment of seed was sent home by William Lobb[4] in 1851.

*P. Coulteri* is rare in cultivation, and the finest specimens appear to be in Herts, where a tree at St. Cross, Hoddesdon, planted by Miss Warner in 1857 (Plate 279), bore twenty large cones in December 1908, and measured, according to Mr. Clinton-Baker, 80 ft. in height and 9½ ft. in girth, but Elwes, who measured it carefully in February 1909, only made it 74 ft. by 9 ft. 4 in. Its branches, one of which is 36 ft. long, sweep the ground. At The Frythe, Welwyn, a tree, 56 ft. by 8 ft., bore cones in 1906, and had a few old cones persistent on the stem. At Youngsbury, Ware, a tree, planted in 1866, measured 51 ft. by 6 ft. 5 in. in 1907. At Ponfield, a tree, 40 ft. by 3 ft. 10 in. in 1906, also had a cone persistent on the stem at 25 ft. from the ground. At Bayfordbury, a tree planted in 1841 is 56 ft. by 8 ft. 8 in., and in 1909 for the first time bore a single cone. A larger tree here, planted in 1838, was cut down in 1906, when it measured 72 ft. by 8 ft. 11 in. A plank from it is preserved in the forestry museum, Cambridge. At Garston Manor, Watford, the seat of Mr. Watney, Sir Hugh Beevor has measured a tree[5] 75 ft. by 9 ft. 10 in. in girth, dividing into two stems at 15 ft. from the ground, which bore cones in 1909.

At Knaphill Nursery, near Woking, Elwes measured in 1907 a tree, 71 ft. by 8 ft. 10 in., which has since died. A fine healthy tree, with a few cones near the top, growing at Enville Hall, Stourbridge, measured, in 1905, 71 ft. by 9 ft. 7 in. At Orton Hall, Peterborough, there is a fine specimen 70 ft. by 7 ft. 9 in. in 1909, which has only produced a few cones at rare intervals.

The largest tree in Kew Gardens is situated near the Succulent House, and measured 55 ft. by 8 ft. in 1909. There is a healthy tree at Toddington Grange, Gloucestershire, the seat of H. Andrews, Esq., which bore cones in 1909 and measures 62 ft. by 6½ ft. At Tortworth, there was a tree, growing on a slope with a westerly exposure, on the lower shaly beds of carboniferous limestone, cones[6] of which were sent to Dr. Masters in 1896. It died and was cut down in 1902.

We have not seen or heard of any tree in Scotland; but at Powerscourt, Ireland, a tree measured 57 ft. by 7 ft. 1 in. in 1903. (A. H.)

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[1] Mayr, in *Wald. Nordamer.* 332 (1890), states that it attains in favourable conditions a height of 150 ft.; but this great height is not confirmed by Sargent or Jepson.

[2] An account of Coulter's expeditions in Mexico and California is given by Coville in *Bot. Gazette*, xx. 519 (1895).

[3] Loudon, *Encycl. Trees*, 985 (1842).

[4] *Hortus Veitchii*, 343 (1906).

[5] Cones weighing 3 lb. from this tree were shown at a meeting of the Scientific Committee of the Royal Horticultural Society on 10th October 1905.

[6] Two cones, dried after keeping seven years, weigh 1½ lb. each. Masters mentions a tree at Kenfield near Canterbury, which produced cones in 1886. The gardener informs us that it is no longer living.

## PINUS SABINIANA, Digger Pine

*Pinus Sabiniana*, Douglas, in *Trans. Linn. Soc.* xvi. 747 (1833); Loudon, *Arb. et. Frut. Brit.* iv. 2246 (1838); Lawson, *Pin. Brit.* i. 85, t. 11. (1884); Masters, in *Gard. Chron.* iv. 44, fig. 4 (1888), and v. 44, fig. 6 (1889), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 597 (1904); Sargent, *Silva N. Amer.* xi. 95, tt. 569, 570 (1897), and *Trees N. Amer.* 23 (1905); Kent, Veitch's *Man. Conif.* 375 (1900); Clinton-Baker, *Illust. Conif.* i. 50 (1909).

A tree, usually 20 to 50 ft. high, occasionally attaining 80 ft. in height and 12 ft. in girth. Bark about 2 in. thick, dark brown, irregularly divided into thick connected scaly ridges. Young branchlets slender, glabrous, glaucous, with prominent pulvini. Buds narrowly cylindrical, acute at the apex, about 1 in. long; scales closely appressed, more or less coated with resin, pale brown, with long white fimbriæ on the margins.

Leaves in threes, persistent for three years, spreading or drooping, 7 to 12 in. long, $\frac{1}{24}$ in. wide, twisted, greyish green, with numerous stomatic lines on the three surfaces, serrulate, ending in a cartilaginous point; resin-canals median; basal sheath 1 in. long.

Cones lateral, on stout stalks, pendulous, ovoid, dark brown, 6 to 10 in. long, 4 to 5 in. in diameter; scales thick, about 2 in. long and 1 in. broad, with an obliquely raised pyramidal apophysis, prolonged into a hooked process, usually ending in a sharp incurved spine. Seeds in deep hollows on the scale, oblong, dark brown or blackish, $\frac{3}{4}$ in. long, $\frac{1}{3}$ in. wide, with a thick shell, encircled by the wing, which is reduced to a very narrow sharp rim below, expanding above into a brown thickened membrane, about $\frac{1}{3}$ in. long. The seeds are eaten and distributed by the Douglas squirrel, and, having a sweet resinous flavour, were formerly used as food by the Indians of California. Cotyledons about 15 to 18.

This species is readily distinguished from *P. Coulteri* by the greyish green foliage and slender glaucous branchlets. Both have very massive cones, with spurred scales, armed with spines, and very large seeds, differing, however, in the length of the wing. The cones of *P. Sabiniana* are shorter and broader, and in this country open more freely than those of *P. Coulteri*. According to Jepson,[1] the trees in Mitchell Cañon, Mount Diablo, which he refers to *P. Coulteri*, resemble very closely those of *P. Sabiniana* in cones and foliage, and are intermediate between the two species.

This pine, which often divides into three or four stems 14 to 20 ft. above the ground, forming a round-topped tree, remarkable for the sparseness of its foliage, is scattered singly or in small groups over the dry and hot foot-hills of the inner Coast Range, of the Sacramento Valley, and of the Sierra Nevada, throughout almost the whole length of California, attaining its largest size east of the Sierra Nevada near the centre of the state, where it is often the most conspicuous feature of the vegetation.

Muir, in an article in *Harper's Magazine*,[2] notes that in the Sierra Nevada it grows only in the torrid foot-hills, often amongst thickets of scrubby oaks, Ceanothus, and Manzanita, and ranges from 500 to 4000 ft. elevation. No other tree that he knows, is so thin and pervious to light, even the largest giving no shade.

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[1] *Flora W. Mid. California*, 22 (1901).

[2] Reproduced in *Gard. Chron.* iv. 44 (1888).

In California *P. Sabiniana* is occasionally tapped, and exudes a nearly colourless liquid with a strong aromatic smell, resembling that of oil of orange, which is sold in San Francisco under the names abietene, erasine, aurantine, or theoline, as a substitute for benzine in removing grease spots from clothes. Wenzell described[1] in 1871 as abietene the hydrocarbon obtained by distilling the crude product; and Thorpe[2] afterwards showed that this was pure heptane, of which he obtained as much as 7 litres from 7½ litres of the liquid exudation of the tree.

This species was discovered by Douglas in 1826, but he did not send seeds till 1832, when plants were raised in the Horticultural Society's garden. It is very rare in cultivation, and is not quite hardy, as Palmer mentions a tree, 46 ft. high, at Rolleston Hall, Staffordshire, which was killed in the severe winter of 1860. A tree planted at Bayfordbury in 1837 was also killed in the same year.

There is a fine tree at Madresfield Court, close to the church, which when measured by Elwes in 1908 was 60 ft. high by 6 ft. 9 in. in girth. It has borne ripe cones, and there were young ones near the top in 1908. At Ledbury, in Lord Biddulph's grounds, a tree (Plate 280) 65 ft. high by 9½ ft. in girth bore cones in 1909. A tree at Tortworth, planted by Lord Ducie in 1856, is now about 63 ft. high and 7 ft. in girth below the fork. It is, however, sickly in appearance. A tree at Eastnor Castle, 62 ft. by 6½ ft., bore fruit in 1908.

At Orton Longueville, a tree with a large lateral branch at 20 ft. up, measured 58 ft. by 7 ft. 8 in. in 1909. At Hunstanton Hall, Norfolk, the seat of Hamon le Strange, Esq., there are fourteen trees growing in the park, variable in height, some with single stems, others branching into two or three stems. The largest is 52 ft. by 7 ft.; and only one tree is bearing fruit, a single old cone.

There are two trees in Kew Gardens, the larger[3] of which, in 1909, was 55 ft. high and 6 ft. 4 in. in girth. A tree at Flitwick Manor, Bedford, was reported in 1908, by Mr. H. Clinton-Baker, to be 50 ft. high and 4 ft. 4 in. in girth. Miss Woolward sends us a branch from a tree, 40 ft. high and 4 ft. in girth, growing in a field belonging to Mr. Kennet-Were, Cotlands, Sidmouth. Kent reports trees at Pampisford, Cambridge, and at Highnam Court, Gloucestershire, which appear to be no longer in existence. (A. H.)

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[1] In a paper read before the Californian Pharmaceutical Society on 13th December 1871, and reprinted in *Pharm. Journ.* for 30th March 1872.

[2] *Journ. Chem. Soc.* xxxv. 296 (1879) and xxxvii. 213 (1881). Cf. *Pharm. Journ.* iii. 2, p. 789.

[3] Figured in *Gard. Chron.* v. 44, fig. 6 (1889).

## PINUS PONDEROSA, Yellow Pine

*Pinus ponderosa*, Lawson, *Agric. Manual*, 354 (1836); Loudon, *Arb. et Frut. Brit.* iv. 2243 (1838); Forbes, *Pinet. Woburn.* 44, t. 15 (1839); Sargent, in *Garden and Forest*, viii. 392 (1895), *Silva N. Amer.* xi. 77, tt. 560, 561 (1897), and *Trees N. Amer.* 15 (1905); Masters, in *Gard. Chron.* viii. 557, figs. 110, 111, 114, 115 (1890), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 593 (1904); Kent, Veitch's *Man. Conif.* 363 (1900); Shaw, *Pines of Mexico*, 24, pl. 17 (1909); Clinton-Baker, *Illust. Conif.* i. 45 (1909).

*Pinus Benthamiana*, Hartweg, in *Journ. Hort. Soc.* ii. 189 (1847), and iv. 212, with fig. (1849).

*Pinus brachyptera*, Engelmann, in Wislizenus, *Tour in N. Mexico*, 89 (1848).

*Pinus Beardsleyi*, Murray, in *Edin. New Phil. Journ.* i. 286 (1855).

*Pinus Craigana*, Murray, in *Edin. New Phil. Journ.* i. 286 (1855).

*Pinus Engelmanni*, Torrey, in *Pacific Rly. Rep.* iv. 141 (1856).

*Pinus Parryana*, Gordon, *Pinetum*, 277 (1875).

A tree, attaining in America 150 to 230 ft. in height, and 15 to 25 ft. in girth. Bark for eighty to a hundred years broken into rounded ridges, covered with small appressed brownish scales; on older trees 2 to 4 in. thick, deeply divided into large plates, separating on the surface into thick reddish scales. Young branchlets stout, glabrous, shining, reddish, becoming nearly black in the second or third year. Buds cylindric-conic, acute, ¾ in. long; scales reddish brown, closely appressed, resinous.

Leaves in threes, persistent three years, spreading, densely crowded on the branchlets, 6 to 10 in. long, 1/20 to 1/12 in. broad, rigid, curved, marked with stomatic lines on the three sides, serrulate, ending in a sharp cartilaginous point; resin-canals median; basal sheath ⅞ in. long. The lanceolate-acuminate fimbriated scale-leaves persist long on the branchlets.

Cones sub-terminal, solitary or clustered, sessile or sub-sessile, spreading or slightly deflexed, ovoid, 3 to 5 in. long, light reddish brown; scales oblong, about 1¼ in. long, ½ in. wide, thin towards the base and thickened at the apex; apophysis rhomboidal, with a sharp transverse ridge and elevated umbo, armed with a slender prickle. Seed oval, about ¼ in. long, with a dark, mottled shell; wing about 1 in. in length. The cones shed their seeds[1] at the end of the second year, and usually fall soon after, generally leaving some of the lower scales attached to the peduncle on the branch; and hence this species and its varieties are called "broken-cone pines" by Lemmon.

This species spread over an immense area, consists of a number of geographical races which have been distinguished as distinct species by various authors. As these gradually pass into one another, and do not occupy isolated areas, they are best treated as varieties.

1. The typical form described above occurs mainly on the Pacific slope, where it grows to a large size, and is mainly distinguishable from var. *Jeffreyi* by its glabrous, shining, non-glaucous branchlets, which emit when cut an odour of turpentine, and its resinous buds with appressed scales. The cones are ovoid-conic,

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[1] R. Douglas states that seeds of this species germinate as well in the fifth year as in the first. Cf. *Gard. Chron.* iv. 185 (1888).

4 to 5 in. long, narrow in proportion to their length. The leaves are variable in size, and average 6 or 7 in. long.

2. Var. *scopulorum,* Engelmann, in Brewer and Watson, *Bot. Calif.* ii. 126 (1880).

> *Pinus ponderosa*, Engelmann, in *Amer. Journ. Sci. Arts*, xxxiv. 332 (1862) (not Lawson); Hooker, in *Gard. Chron.* ix. 796, fig. 138 (1878).
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> *Pinus scopulorum*, Lemmon, in *Garden and Forest*, x. 183 (1897); Mayr, *Fremdländ. Wald- u. Parkbäume*, 370 (1906).

Usually 50 to 75, occasionally 150 ft. in length, and 4 ft. in diameter. Bark dark and furrowed, or bright red broken into large plates. Leaves in clusters of both twos and threes, 3 to 6 in. long. Cones, in clusters of two, ovoid-conic, smaller than in the type, about 3 in. long. This variety occurs in the Rocky Mountains and eastward, in eastern Montana, Nebraska, Dakota,[1] Colorado, western Texas, northern New Mexico, and Arizona.

3. Var. *Jeffreyi*, Vasey, *U.S. Rep. Dept. Agric.* 179 (1875); Sargent, *Silva N. Amer.* xi. 79, tt. 562, 563 (1897), and *Trees N. Amer.* 16 (1905); Kent, Veitch's *Man. Coniferæ*, 364 (1900); Shaw, *Pines of Mexico*, 24 (1900).

> *Pinus Jeffreyi*, Balfour, *Bot. Exped. Oregon*, 2, fig. (1853); Lawson, *Pin. Brit.* i. 45, t. 6 (1884); Masters, in *Gard. Chron.* v. 360, fig. 65 (1889); Clinton-Baker, *Illust. Conif.* i. 27 (1909); Hemsley, in *Bot. Mag.* t. 8257 (1909).
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> *Pinus deflexa*, Torrey, in Emory, *Rep. Mex. Bound.* 209 (1858); Murray, in *Gard. Chron.* iv. 295, fig. 65 (1875).

Attaining 150 to 200 ft. in height, and 20 ft. in girth. Bark bright red, divided into large irregular scaly plates. Young branchlets glaucous, exhaling, when cut, an aromatic odour like that of lemon. Buds reddish brown, non-resinous, and with the points of the scales free. Cones ellipsoid, very large, 5 to 12 in. long, short-stalked, with either stout or slender recurved prickles. Seeds often ½ in. long, with long wings. This variety occurs in the Sierra Nevada, San Bernardino, San Jacinto, and Cuyamaca mountains in California, and on the San Pedro Martir mountain in Lower California.

4. Var. *Mayriana*, Sargent, *Silva N. Amer.* xi. 81 (1897).

> *Pinus latifolia*, Sargent, in *Garden and Forest*, ii. 496, fig. 135 (1889); Brandegee, in *Garden and Forest*, v. 111 (1892); Koehne, *Deut. Dendr.* 36 (1893).
>
> *Pinus Engelmanni*, Lemmon, in *Erythea*, i. 134 (1893) (not Torrey or Carrière).
>
> *Pinus Mayriana*, Sudworth, *U.S. Forestry Bull.* No. 14, p. 21 (1897); Mayr, *Fremdländ. Wald- u. Parkbäume*, 367 (1906).

Leaves very long and stout, 14 to 15 in. long, $\frac{1}{16}$ in. broad. Cones very oblique; scales with projecting knobbed umbos, armed with sharp prickles.

This variety,[2] said to be a tree about 80 ft. high, was discovered on the southern slope of the Santa Rita mountains in Arizona by Mayr in 1887.

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[1] Cf. Graves, *Black Hills Forest Reserve*, published in *U.S. Geol. Survey*, 1897-98, pt. v. *Forest Reserves* (1899).

[2] Toumey, in *Garden and Forest*, viii. 22, fig. 4 (1895), figures this tree, or a similar form, on Mount Chiricahui, in south-eastern Arizona, and believes that all the varieties of *P. ponderosa* occur there, gradually passing into one another. Lemmon, in *Erythea*, ii. 103, fig. 3 (1894), describes and figures the Chiricahui pine as *P. apacheca*.

5. Var. ***arizonica***, Shaw, *Pines of Mexico*, 24 (1909).

*Pinus arizonica*, Engelmann, in Rothrock, *Rep. Geol. Surveys*, vi. 260 (1878); Sargent, *Silva N. Amer.* xi. 75, t. 559 (1897), and *Trees N. Amer.* 14 (1905).

A tree 80 to 100 ft. high, with black and deeply furrowed bark. Young branchlets glaucous. Leaves usually in fives, but occasionally also in threes, according to Shaw. Cones ovoid, small, 2 to 2½ in. long.

This occurs on the sides of cañons of the mountain ranges of southern Arizona at 6000 to 8000 ft. elevation, sometimes forming nearly pure forests. It is more abundant and attains its largest size on the sierras of northern Mexico, in Sonora, Chihuahua, and Nuevo Leon.

6. Var. ***macrophylla***, Shaw, *Pines of Mexico*, 24 (1909).

*Pinus macrophylla*, Engelmann, in Wislizenus, *Tour N. Mexico*, 103 (1848), and in *Trans. St. Louis Acad.* iv. 181 (1880).

*Pinus Engelmanni*, Carrière, in *Rev. Hort.* 227 (1854).

A tree 70 to 80 ft. high. Leaves 12 to 16 in. long, stout, in threes, fours, and fives. Cones large (according to Engelmann, 4½ in. long); scales with apophysis prolonged into a reflexed protuberance, armed with either a stout or slender prickle.

Discovered by Wislizenus on the mountains of Cosiquirachi, where it is said to be abundant. According to Shaw, it occurs in Sonora and Chihuahua in northern Mexico. (A. H.)

## DISTRIBUTION AND HISTORY

This splendid tree is the most important species of pine in western North America, being the most widely distributed, the largest except *P. Lambertiana*, and the most variable. It occurs over a vast region, extending eastwards to Montana, the Black Hills of Dakota, Nebraska, Colorado, and western Texas, and westwards to the shores of the Pacific, attaining its most northerly limit in the dry interior of British Columbia,[1] in the north Thompson valley, and around Shushwap lake, in lat. 51½°, descending the Fraser river to thirty miles above Yale. It reaches southwards to Lower California, Arizona, New Mexico, and northern Mexico. It is essentially a tree of dry regions and sunny aspects, yet able to endure a great degree of cold in winter. It is the first pine which the traveller sees on going west across the prairies in western Nebraska,[2] and forms the greater part of the forests, now rapidly disappearing, which cover the Black Hills of Dakota, where it attains a maximum height of 100 ft. and a diameter of 19 in.

In Montana it becomes a larger tree, attaining a height of 150 ft. on the dry slopes of the mountains near Helena, where it ascends to 6000 ft., in company with the Douglas fir and Western larch. In the Flathead valley it grows in scattered groups on the margin of the prairie in the plain of Kalispell, and gradually advances into the dense mixed coniferous forest of the surrounding mountains. Plate 281, from a negative taken by Prof. Elrod, represents a yellow pine near Flathead Lake. Near Whitefish, Henry measured an average tree, 148 ft. in height and 11½ ft. in girth, which showed when felled 3½ in. thick of bark, 3 in. of sapwood, and 360 annual rings. In the Blackfoot valley, near Missoula, I measured a tree 140 ft. high by 15 ft. in girth.

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[1] Macoun, *Cat. Canad. Plants*, i. 466. Palmer, in *Brit. Columbia Bull.* No. 21, p. 10 (1905), gives its habitat as the dry plateau between the Coast and Gold Ranges, where it is largely used for lumber. The seeds were formerly eaten by the natives.

[2] Bessey, in *Bot. Gazette*, xxii. 245 (1896), gives its distribution in Nebraska, as along the northern border in the valley of the Niobrara river, in the south-western corner, along the river Platte, where I saw it in 1904, and in patches in the centre of the state in cañons of the Loup.

In Colorado the mountain form[1] forms very extensive pure forests on the plateau between 7000 and 8200 ft., ascending occasionally to 9000 ft., and descending to 4500 ft. Here the tree rarely exceeds 80 ft. in height and 3 ft. in diameter. It extends southwards along both sides of the Rockies to western Texas, northern New Mexico, and Arizona, exhibiting in the latter state several peculiar forms, which have been distinguished, on account of their very long needles and peculiar cones, as distinct species (*P. Mayriana*, *P. apacheca*). It also spreads into the northern states of Mexico[2] in varieties with leaves varying in number, distinguished as *P. macrophylla* and *P. arizonica*, the latter being also a native of Arizona.

In wet regions, like the coast of British Columbia and Vancouver Island, the tree is unknown; but it grows in Washington, close to Puget Sound, on dry gravelly prairies. In eastern Washington it forms an open pure forest on the lower timber line, bordering on the arid region, and ranges from 400 to 6200 ft. According to Piper,[3] it has a marked preference for granitic soil, though it grows on basaltic clay in the Blue Mountains. It here attains its maximum development at 2000 ft., reaching a height of 200 ft. and a diameter of 6 ft. It is common along the eastern slopes and foothills of the Cascade range, and becomes a conspicuous tree in southern Oregon, where the climate is drier, forming considerable forests at Grant's Pass and in the Siskiyou mountains.

In California it occurs in the coast ranges,[4] as in Sonoma and Napa counties, and there is a fine forest of this species on the Howell mountain plateau; but no trees are known in the inner coast ranges bounding Solano and Yolo counties. It is not recorded from the San Francisco Bay ranges, except from the Mt. Hamilton ridges. It is abundant in the Sierra Nevada, at or above 5000 ft.; and, according to Muir,[5] ranges on the western slope from 2000 ft. to timber line, and, crossing the range by the lowest passes, descends to the eastern base, and pushes far out into the hot volcanic plains. The largest tree measured by Muir grew in the Merced valley, and was 220 ft. high and 8 ft. in diameter.

Var. *Jeffreyi* occurs in California,[6] from Scott's Mountain in Siskiyou county, and along the eastern slopes of the Sierra Nevada, forming large forests at the headwaters of the Pitt and M'Cloud rivers, and often grows on the most exposed and driest ridges, wandering out among the volcanoes of the Great Basin. Sudworth records it from Douglas county in southern Oregon; and it is the chief pine on the lower slopes of Mount Shasta, which it ascends to about 5500 ft., the largest that I measured here being 120 ft. high by 13½ ft. in girth. It extends southwards to the San Bernardino and the San Jacinto ranges, up to 8000 ft. elevation, in the Cuyamaca mountains, and finds its most southerly point[1] on the San Pedro Martir mountain,[2] in Lower California.

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[1] A tree growing in Monument Park, Colorado, is figured by Sir J. Hooker in *Gard. Chron.* ix. 796, fig. 138 (1878).

[2] Shaw, *op. cit.* 2, states that *P. ponderosa* extends in Mexico southwards to lat. 23° or 24°.

[3] *Contrib. U.S. Nat. Herb.* xi. 50, 92, tt. xiv. xv. (1906).

[4] Jepson, *Flora W. Mid. California*, 21 (1901).

[5] In *Harper's Magazine*, xxii. 719.

[6] Sir J. Hooker, in *Gard. Chron.* xxii. 814, fig. 141 (1884), gives a sketch of a tree growing in the Silver Mountains in the Sierra Nevada range, on the eastern slope, and says he met with no specimens nearly so large as 200 ft., the height given by Sargent.

*P. ponderosa* was first mentioned by Lewis and Clarke, who saw it in 1804 on the Upper Missouri, on their memorable journey across the Rocky Mountains. It was not made known to science, however, until David Douglas found it[3] on the Spokane river, in Washington, in 1826, and in the *Companion to the Botanical Magazine*, ii. 111, published in 1836, mentioned it as a new pine under the name of *P. ponderosa*. This name was taken up in 1836 by Lawson,[4] to whom Sargent attributes its description, which was taken from a tree in the Caledonian Horticultural Society's Garden, raised from the seeds sent by Douglas in 1827 to the London Horticultural Society.

The variety *Jeffreyi* was discovered by Jeffrey in October 1852 in the Shasta valley, in northern California, and introduced in the following year.[5]

## CULTIVATION

So far as I have seen, this tree succeeds best and attains the greatest size on dry, well drained, but deep soil in the south of England, while it often becomes unhealthy and dies in damp situations; and, though perfectly hardy[6] in Scotland, is not so large or so thriving there as in the south. It ripens seeds freely in good seasons, from which many plants have been raised at Tortworth and other places. The seedlings are best raised in a box and planted out when a year or two old; when once established they grow fast, and do not seem to suffer from early or late frosts.

There are several trees of *P. ponderosa* in England, which are about 90 ft. in height and some over; but we have seen none to equal the tree at Powis Castle near the Welshpool entrance to the park, which, when I measured it in 1908, was 105 ft. high[7] and 10 ft. in girth with a clean bole of about 60 ft.

At Bayfordbury a tree planted in 1837, and growing on good loamy soil, was carefully measured with a sextant and different base lines in 1906, when it was 100½ ft. in height, its girth being 9 ft. 4 in. Exactly three years later, in April

[1] The southern form, growing on the mountains east of the San Rafael valley of southern California, and on the mountain of San Pedro Martir, in a dry climate, is figured in *Garden and Forest*, v. 184, fig. 28 (1892), under the name *P. Jeffreyi*, var. *peninsularis*, Lemmon, in *3rd Report Calif. State Forestry Board*, p. 200 (1891).

[2] Brandegee, in *Zoe*, iv. 201 (1893), describes this mountain as a plateau 7000 to 8000 ft. elevation, with ridges 2000 to 3000 ft. higher. It is cold in winter, ice lasting until May, and the rainfall is considerable. *P. Jeffreyi* is the most common tree on the plateau, a few trees of *P. Lambertiana* occurring on the ridges. *P. Parryana* is common at lower elevations than the plateau.

[3] A specimen, collected by Douglas, in the Kew Herbarium, bears a parasitic plant, *Arceuthobium occidentale*, Engelm., figured by Loudon, t. 2137, as *A. oxycedri*, Bieb.

[4] Lawson, *Agricultural Manual*, 354 (1836).

[5] These particulars are taken from Jeffrey's advice note, which Prof. I. B. Balfour has allowed us to consult.

[6] At Thorpe Perrow, Bedale, all the conifers raised from seeds collected by Hartweg were killed in the severe winter of 1860-61, when 46° of frost were registered, except *P. Benthamiana*, the Californian coast variety of *P. ponderosa*, of which two fine trees were surviving in 1888. Cf. *Gard. Chron.* iii. 236 (1888).

[7] This is the tree mentioned in the notes supplied to the Royal English Arboricultural Society on their visit in 1909 as a Corsican pine, No. 6.

1909, two measurements taken by Mr. H. Clinton-Baker make it 101 ft. by 9 ft. 7 in. It girthed in 1865, 4 ft. 9 in., and in 1900, 9 ft. Sir H. Beevor has measured another at Garston Manor, Watford, 90 ft. by 8 ft. 2 in.

Another at Dropmore is believed to be one of Douglas's original seedlings, planted in 1829, and, as measured by Mr. Page in 1909, was 99 ft. by 8 ft. 9 in.; in 1905 I made it 92 ft. by 8½ ft. At Arley Castle two trees of the same origin, measured by Mr. R. Woodward in 1909, were 104 ft. by 7 ft. 8 in., and 96 ft. by 6 ft. 7 in. At Highnam there is a tree 72 ft. by 9 ft. 4 in. At Escot St. Mary, Miss F. Woolward measured a tree 94 ft. by 7 ft. 8 in. At Brocklesby Park, Mr. Havelock measured, in 1904, a tree 87 ft. by 6 ft. 10 in. On the heavy clay at Orton Longueville the largest is only about 70 ft. by 7½ ft.

In the damper climate of the west it does not seem to grow so fast, the best tree at Killerton being only 72 ft. by 6½ ft. At Eastnor Castle, there are two trees of the typical form, 65 ft. by 7 ft., and 65 ft. by 8 ft. 4 in., and a specimen of var. *Jeffreyi*, 58 ft. by 5 ft., all the measurements being taken by Mr. Mullins in 1909. Var. *Jeffreyi* is 60 ft. by 5 ft. 3 in. at Westonbirt, and 56 ft. by 5 ft. 1 in. at Orton.

In Wales I have not noticed any specially noteworthy trees, the climate at Penrhyn being clearly too wet to suit its requirements.

In Scotland the best we have seen is at Smeaton Hepburn. A tree[1] of var. *Jeffreyi*, planted in 1856, measured in 1902, 72 ft. high and 4 ft. 9. in. in girth. A tree at Scone, Perthshire, measured[2] in 1891, 50 ft. by 6 ft. 8. in.

Though it grows fairly well in central and eastern Scotland, we have seen no large trees in the west, and Sir H. Maxwell mentions none.

In Ireland also it seems to be unsuccessful; none of the reports of the Conifer Conference in 1891 speak well of it, and we have seen no trees worth recording for their size.

In Germany cones matured[3] for the first time in 1894, on a tree at Schaffenberg, near Berlin, which was 25 ft. high and growing with great vigour and apparently hardy. Both *P. ponderosa* and var. *Jeffreyi* have been experimented with in forest plots[4] in Prussia, and succeeded for a time, but afterwards for some inexplicable reason gradually withered and died. The seedlings are very liable to the leaf-shedding disease, *Lophodermium Pinastri.*

As a timber tree it is not likely to have any importance in Europe, the timber being coarse in comparison with that of the native species. In North America, however, it is one of the most useful for mining and general building purposes.

As a rule, according to Sargent,[5] *P. ponderosa* and its varieties have not proved satisfactory in the eastern states. The long-leaved Californian forms are not hardy in New England. Var. *scopulorum* is hardy near Boston, where it is impossible, however, to keep it alive more than a few years, as a fungoid disease disfigures and soon destroys it. Var. *Jeffreyi* is more successful, and the best specimens probably in the eastern states are in Delaware Park, Buffalo, where there are eight trees which, planted in 1871, were in 1897, 25 to 37 ft. high. A fine weeping variety, var. *pendula*, Masters, which was imported from England in 1851, and planted at Woodenethe, Fishkill on Hudson, New York, is figured[1] in *Garden and Forest*, i. 392, fig. 62 (1888); and was, in 1882, 59 ft. high and 5 ft. 7 in. in girth. We have not seen any tree showing this habit either in England or in its native country.

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[1] *Hist. Berwickshire Nat. Club*, xviii. 211 (1904).

[2] *Journ. Roy. Hort. Soc.* xiv. 536 (1892).

[3] *Garden and Forest*, vii. 95 (1894), where it is stated that at Berlin *P. Sabiniana* succumbed in the severe winter of 1893; while *P. Coulteri* is hardy, but grows slowly.

[4] Cf. Schwappach, *Anbauversuche fremdländ. Holzart.* 57 (1901), and Unwin, *Future Forest Trees*, 57 (1905).

[5] *Garden and Forest*, x. 470 (1897).

(H. J. E.)

## PINUS TUBERCULATA, KNOB-CONE PINE

*Pinus tuberculata*, Gordon, in *Journ. Hort. Soc.* iv. 218 (1849), and *Pinetum*, 288 (1875), (not D. Don); Lawson, *Pinet. Brit.* i. 93, t. 13 (1884); Masters, in *Gard. Chron.* xxiv. 786, fig. 184 (1885), and *Journ. Linn. Soc.* (*Bot.*) xxxv. 594 (1904); Kent, Veitch's *Man. Conif.* 386 (1900); Sargent, in *Bot. Gaz.* xliv. 227 (1907); Clinton-Baker, *Illust. Conif.* i. 57 (1909).

*Pinus californica*, Hartweg, in *Journ. Hort. Soc.* ii. 189 (1847) (not *P. californiana*, Loiseleur).

*Pinus attenuata*, Lemmon, in *Mining and Scientific Press*, Jan. 16, 1892, *ex* Sargent, *Silva N. Amer.* xi. 107, tt. 575, 576 (1897); Sargent, *Trees N. Amer.* 22 (1905).

A tree, usually 20 to 30 ft. high and 1 ft. in diameter, occasionally attaining 100 ft. in height and 2½ ft. in diameter; often divided about the middle into two ascending stems. Bark ¼ to ½ in. thick, brown, irregularly broken into large loose scales. Young branchlets slender, glabrous, reddish brown, with prominent pulvini separated by linear grooves. Buds cylindrical, pointed, brown, about an inch long, with closely appressed scales.

Leaves in threes, persistent three or four years, spreading, usually 4 to 5 in. long, slender, firm and rigid, serrulate, ending in a sharp cartilaginous point, marked by stomatic lines on the three surfaces; resin-canals median; basal sheath ½ in. long.

Cones lateral, in one, two, or three whorls on the same year's shoot, in clusters of two to four, deflexed, asymmetrical, oblique at the base, short-stalked, pale brown, elongated-conical, 3 to 5 in. long; scales thin, flat; apophyses transversely keeled, on the outer side of the cone, pyramidate, raised into conical knobs, and armed with sharp spines, on the inner side flattened and with minute prickles. Seed oval, black, grooved, ¼ in long; wing about an inch long.

The cones are developed at an early age, often appearing in whorls on the stem, when it is only 2 or 3 ft. high; and remain both on the stem and branches unopened until the advent of a forest fire or the death of the tree. They are sometimes found embedded in the bark of old trunks.

This species is found in arid sunny situations on the mountains of south-western Oregon, south of the Mackenzie river, in the Siskiyou mountains, and southward along the western slopes of the Cascades and the Sierra Nevada, and in the coast range of California from Santa Cruz to the San Bernardino mountains, where it is abundant at 4000 ft. It is most common in Oregon, usually growing in small groves amidst the chaparral, and where I saw it on the boundary between Oregon and California, never attained a greater height than 30 ft. with a maximum diameter of a foot, all the trees being narrowly pyramidal with short branches, and bearing numerous whorls of unopened cones on the main stem. Its range here appears to be between 2500 and 3000 ft. Sargent says it occasionally attains a height of 100 ft., but neither Mr. F. R. S. Balfour nor myself saw any but small trees, those of exceptional size being probably restricted to deep ravines on good soil. The hills on which it grows are very liable to be swept by forest fires, and there is no doubt that it rarely if ever reproduces itself, except on burnt areas,[1] when the scorched cones let out the seeds. It is often attacked by mistletoe. In the same region it is occasionally accompanied by a peculiar variety of *P. contorta* with small cones, a tree of similar size and habit.

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[1] This tree is also figured in *Gard. Chron.* x. 236, fig. 42 (1878).

*P. tuberculata* was discovered by Hartweg[2] in 1847 in the Santa Cruz mountains, about twenty miles north of Monterey, and was introduced by him into the garden of the Horticultural Society, London, in the same year. This species grows slowly in England, and is of rare occurrence in collections; the best specimen we have seen is a tree 50 ft. high at Bury Hill, Dorking, which divides into several stems at 1 ft. from the ground, where it girths 10 ft. 5 in. There is an ill-shaped and decaying tree at Bayfordbury, 36 ft. high, dividing at 3 ft. from the ground into two stems, 3 ft. and 3½ ft. respectively in girth. A branch of the tree 4 ft. in length bore forty-one cones. A tree at The Heath, Leighton Buzzard, measured by A. B. Jackson in 1908, was about 35 ft. high. Smaller specimens occur at Kew, Blackmoor in Hants, and Ochtertyre.

In New Zealand,[3] this species is a rapid grower, second only to *P. radiata*. At Canterbury, three varieties have arisen, all of which come true from seed and are very constant in character. (A. H.)

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[1] A graphic account of this pine and its relation to forest fires, by Muir in *Harper's Magazine*, xxii. 715, is reproduced in *Gard. Chron.* xxiv. 786 (1885). Jepson, in *Flora W. Mid. California*, 23 (1901), says that a burnt forest of the knob-cone pine is promptly re-sown with its own seed.

[2] Hartweg described it in *Journ. Hort. Soc.* ii. 189 (1847), but erroneously supposed it to be identical with *P. californiana*, Loiseleur.

[3] Adams, *Genus Pinus*, 6, paper read at the Philosophical Institute, Canterbury, New Zealand, 7th August 1907.

## PINUS RADIATA, Monterey Pine

*Pinus radiata*,[1] Don, in *Trans. Linn. Soc.* xvii. 442 (1836); Sargent, *Silva N. Amer.* xi. 103, tt. 573, 574 (1897), and *Trees N. Amer.* 21 (1905); Kent, Veitch's *Man. Coniferæ*, 370 (1900); Masters, in *Journ. Linn. Soc.* (*Bot*) xxxv. 595 (1904).

*Pinus tuberculata*, Don, *loc. cit.* (not Gordon).

*Pinus insignis*, Douglas, *ex* Loudon, *Arb. et Frut. Brit.* iv. 2265 (1838); Forbes, *Pin. Woburn.* 51, t. 18 (1839); Lawson, *Pin. Brit.* i. 37 (1884); Baines, in *Gard. Chron.* ix. 108, figs. 22, 23 (1878); Masters, in *Gard. Chron.* ix. 337, fig. 77 (1891); Clinton-Baker, *Illust. Conif.* i. 26 (1909).

*Pinus Sinclairii*, Hooker et Arnott, *Bot. Beechey's Voyage*,[2] 392, t. 93 (1841).

*Pinus Montereyensis*, Rauch, *ex* Gordon, *Pinetum*, 197 (1858).

A tree, attaining at Monterey about 100 ft. in height and 20 ft. in girth. Bark about 2 in. thick, dark brown, deeply divided into broad flat scaly ridges. Young branchlets glabrous, reddish brown, with prominent pulvini. Buds $\frac{1}{2}$ to $\frac{3}{4}$ in. long, cylindrical, pointed, brown; scales closely appressed and coated with resin.

Leaves in threes, persistent three years, densely crowded on the branchlets, bright green, 4 to 5 in. long, about $\frac{1}{16}$ in. broad, slender and flexible, serrulate, ending in a short cartilaginous tip, marked with stomatic lines on the three sides; resin-canals median; basal sheath $\frac{1}{2}$ in. long.

Cones lateral, on stout short stalks, solitary or in clusters of two or three, deflexed or spreading, about 3 to 5 in. long, ovoid with a pointed apex, shining brown, very asymmetrical, with the scales much thickened from the middle to the base on the outer side, their apophyses elevated into protuberances, directed downwards; elsewhere with the apophyses flatter, rhomboidal, marked with a transverse linear ridge and a dark brown umbo, armed with a minute prickle. Seed oval, about $\frac{1}{4}$ in. long, blackish and tuberculate; wing light brown, with darker longitudinal stripes, about an inch long.

In this species the shoots, when vigorous, are multinodal, and often show a ring of buds in the middle of the branchlet, as well as one subtending the terminal bud. At Monterey,[3] the shoots regularly produce two whorls of cones; and many trees show three, four, or even five whorls, but in this case many of the cones remain unfertilised and shrivel up at the beginning of the second year. In cultivated trees in this country and in dense stands at Monterey the cones are persistent, remaining unopened on the branches for several years, or in some cases even retaining the cones on the main stem or on the largest and oldest branches. In exposed trees at Monterey, the cones usually open, immediately after ripening, with the onset of the warm weather that occurs in autumn.

The seedlings have five to seven cotyledons, and are variable in habit, some young plants giving off lateral shoots immediately above the cotyledons, while others have a long unbranched stem.[1] The primordial needles are very long, narrow, and finely serrate; and are succeeded by the ternate leaves when the stem attains 6 or 8 in. in height.

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[1] This is the oldest certain name, and the one exclusively used by American botanists and foresters. *P. adunca*, Poiret, in Lamarck, *Encycl. Suppl.* iv. 418 (1816), may be this species, but the description is very imperfect.

[2] The drawing and description represent a large coned form of *P. radiata*. The cone in the Kew Museum labelled "*P. Sinclairii* (?)" is *P. Montezumæ*; but it is not the cone described by Hooker and Arnott; and Engelmann in Brewer and Watson, *Bot. Calif.* ii. 128 (1880), is incorrect in assuming *P. Sinclairii* to be a factitious species.

[3] J. B. Hickman, in *Erythea*, iv. 194 (1896).

## VARIETIES

Both in wild and cultivated trees there is great variation in the size of the cones; and the length of the leaves is not constant. *P. radiata* was formerly supposed to differ from *P. insignis* in having larger cones; but intermediate forms are numerous.[2]

Var. *binata*, Engelmann, in Brewer and Watson, *Bot. California*, ii. 128 (1880).—Leaves usually in twos. Specimens[3] at Kew bear much smaller cones than in the type, symmetrical at the base and with scales not swollen on the outer side. This variety was discovered in 1875 by Dr. Palmer on Guadalupe island, off the coast of Lower California, and was found in 1888 by Brandegee[4] on Santa Cruz and Santa Rosa isles, off Santa Barbara in California. Dr. Franceschi says[5] that this pine is found on the northern and north-western part of Guadalupe, which in times past must have been covered with a dense forest. It grows in company with a palm, *Erythea edulis*, and with *Quercus tomentella*, at considerable elevations. The trees[6] are vigorous and handsome, averaging 70 ft. in height and 7½ ft. in girth. Near the sea they are cut like a hedge owing to the force of the wind.

Var. *aurea.* A form with bright golden foliage has appeared in New Zealand, and is being propagated there for sale.[7]

## DISTRIBUTION

This species has a very restricted distribution, occurring only in a narrow belt a few miles wide on the coast of California from Pescadero to San Simeon Bay; on the islands of Santa Rosa and Santa Cruz off Santa Barbara, and on Guadalupe island, off the coast of Lower California, the insular form belonging as described above, to var. *binata.*

It is most abundant and of its largest size on Point Pinos,[8] south of the Bay of Monterey. At Pacific Grove,[9] where the forest of this pine is extremely important, being the main protection of the town of that name against the sand, which now piled up in large dunes would otherwise be blown inland over the town. Paths and roads have been cut through the forest, and a few years ago a serious fire swept over part of it, so that the pine is now having a hard struggle for existence.

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[1] Cf. *Gard. Chron.* ix. 337 (1891).

[2] Large cones, var. *macrocarpa*, Gordon, *Pinetum*, 206 (1858), are said by Hartweg, in *Journ. Hort. Soc.* iii. 226 (1848), to be characteristic of the pines forming a wood at San Antonio, some distance from the sea. Lemmon, however, in *West American Cone-Bearers*, 6 (1895), says that trees with large cones occur near the sea, those with small cones being seen on the outskirts of the forest, farthest from the ocean.

[3] Collected in Guadalupe by Dr. Palmer in 1875, by Dr. Franceschi in 1892, and by A. W. Antony in 1896.

[4] Cf. *Proc. Calif. Acad.* i. pt. ii. 217 (1889).

[5] In *Zoe*, iv. 130 (1893).

[6] According to Palmer, in Watson, *Proc. Amer. Acad.* xi. 119 (1876).

[7] Cf. T. W. Adams, *Genus Pinus*, 4, a paper read at the Philosophical Institute of Canterbury, New Zealand, on 7th August 1907. Mr. Adams saved seed from a cone without any knobs on its outer side, and all the trees raised are now bearing cones of the ordinary type. A number of varieties have arisen in New Zealand, remarkable for the variation in the size of the cones and in the colour of the foliage.

[8] Here it mixes slightly with *P. muricata.*

[9] Cf. G. J. Pierce, in *Bot. Gazette*, xxxvii. 448 (1904), who describes the attacks of a fly, *Diplosis pini-radiatæ*, Snow, which produces a basal hypertrophy of the needles of this pine. It is also much attacked by a kind of mistletoe, *Arceuthobium occidentale*, Engelm.; and an interesting account of the dissemination of the seeds of this parasite on the pine is given by Pierce in *Ann. Bot.* xix. 99-113 (1905).

Prof. Jepson informs me that this pine grows on the Monterey peninsula from the sand dunes of the seashore inland over the adjoining hilly ridges, which nowhere exceed 400 ft. elevation. The average rainfall[1] for the twenty-three years, 1878 to 1900, was 15·37 in. annually, occurring on forty to sixty days in the winter from October to April. The months of June, July, and August are perfectly dry. The number of cloudy days in the year varies from 120 to 150. The thermometer never rises above 89° F., and rarely descends below freezing-point, and then only for short periods in the night,—though 24° F. was registered in 1905, and 27° F. in 1906.

This species was discovered[2] by Douglas during his stay at Monterey in 1831 and 1832; and from seeds sent home by him in 1833 plants were raised in the garden of the Horticultural Society and in the Duke of Devonshire's grounds at Chiswick, which were 3 to 5 ft. in height in 1838. Coulter also sent cones at about the same time, from Monterey, which were described by Don as *P. radiata* in 1836. Subsequently, in 1850 and 1851, consignments of seed were sent to Messrs. Veitch by William Lobb.[3] (A. H.)

## CULTIVATION

Near the sea in almost all parts of Great Britain, but especially in the south-west of England, in Wales, and in Ireland, *Pinus radiata* has proved to be a tree of great value for shelter and ornament; and though its timber is too coarse to come into competition with that of Baltic or even home-grown pine, its growth is so extremely rapid that it may prove profitable to grow for mining timber in Cornwall and South Wales.

It produces seed freely at an early age. The seedlings grow more rapidly than those of any other pine which I have raised; and though they are not so easy to transplant as those of the Scots pine, the proportion of losses in transplantation is much less than in the Corsican species. In a mixed plantation made by C. Daubuz, Esq., of Killiow, about two miles from Truro, in 1864, Monterey pines when I saw them in 1902 averaged about 8 ft. in girth, larch 3 ft., chestnut 3 ft., and silver fir about 40 in. The pines were raised from seeds of a home-grown tree under twenty years old; and it seemed to me that in this locality, if planted thick enough and cut at the right size, they might be equal to imported pit-props.

Though the tree is hardy enough to grow in many inland parts of England, it seems to succeed best near the sea; and at Colesborne, though it has endured frosts as low as zero in sheltered places, the growth is slow, the young shoots are often killed back by frost, and in low-lying or exposed situations the trees are killed outright in cold seasons.

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[1] The rainfall, however, has been more considerable lately:—in 1905, 21·63 in.; in 1906, 25·03 in.; and in 1907, 28·98 in.

[2] Colligon, a gardener who accompanied the La Peyrouse expedition, is supposed to have sent a cone of this species to the museum at Paris in 1787, which was described by Loiseleur in *Nouv. Duhamel*, v. 243 (1812) as *P. californiana*. The latter states that a plant raised from the seed of this cone was living in 1812 in the open in the Jardin des Plantes. The seed, however, is described as being large and edible like that of *P. Cembra*, and the foliage as being in twos and threes; and in all probability this plant was *P. Pinea*.

[3] *Hortus Veitchii*, 39 (1906).

In the garden of the Rev. A. Boscawen at Ludgvan, near Penzance, the growth of seedlings is extraordinary, and the ability of the tree to bear sea-winds is greater than that of any other pine. As regards soil it must be well drained and light to ensure success.

Mr. Rogers, of Penrose, Cornwall, says[1] that he planted about 1000 trees, many in the most exposed borders of plantations near the sea in Mount's Bay, most of them being seedlings from his older trees. He considers it one of the best of nurses, giving better shelter and growing faster than either the Austrian or maritime pine; but it suffers severely from snow in a cold winter, losing entire limbs and often dying from its effects.[2] He has used wood of thirty years' growth both for furniture and for wheelbarrows, etc., and finds it easily worked, light in weight, tough and strong, though liable, as might be expected from immature timber, to be worm-eaten. If planted closely, it will produce clean straight timber.

### REMARKABLE TREES

The largest specimens reported in 1891 were at Dropmore, then 90 ft. by 11 ft., planted in 1839, and Boconnoc, then 68 ft. by 13 ft.; but these are now far surpassed by many others.

The most remarkable that I have seen is a tree in a sheltered dell called the Wilderness at Cuffnell's, near Lyndhurst, which in 1907 was 116 ft. by 8½ ft., with a clean bole about 40 ft. long. Plate 282 shows how very unlike this is to its usual habit both in California and England.

The next tallest was a tree, no longer living, which, as I am told by Rev. A. Boscawen, was carefully measured at Heligan in Cornwall in 1897 by the Hon. Charles Ellis, who found it to be 108 ft. high. This was a seedling of unknown age, raised from a tree which I saw on the lawn at Heligan in 1905; a very rugged and wide-spreading tree which, though only about 50 ft. high, was 18 ft. in girth. It was blown down in May 1909.

There are many other very large trees, of which I give particulars in tabular form as follows:—

| | Height. | Girth. | Year. | By whom measured. |
|---|---|---|---|---|
| Haldon House, Devonshire | 90 ft. | 14 ft. 6 in. | 1903 | H. J. Elwes. |
| Heanton Satchville, Devonshire | 92 ft. | 14 ft. | 1905 | " |
| Knowle Hotel, Sidmouth, Devonshire | 83 ft. | 14 ft. 2 in. | 1907 | Miss F. Woolward. |
| Lamorran, Cornwall | 90 ft. | 13 ft. 6 in. | 1905 | H. J. Elwes. Not over fifty years old; very rough tree. |
| Coldrennick, Cornwall | 83 ft. | 14 ft. 5 in. | 1905 | A. Bartlett. |

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[1] *Woods and Forests*, 1883, p. 19.

[2] Loudon, in *Gard. Mag.* xv. 269 (1839), states that plants were killed nearly everywhere in Britain by the severe winter of 1838-39; but one survived at Sunning Hill, in the grounds of Mr. R. Mangles. It was growing on dry elevated ground. A tree at Gunnersbury, 48 ft. high, was reported in *Gard. Chron.* 1868, p. 152, to have been killed by the severe frost of 1867. In the severe winter of 1908-9, when the temperature fell at Kew to 10° F. on 30th December, the leaves on this pine tree were injured, and turned a rusty brown colour. Cf. *Kew Bull.*, 1909, p. 225.

| | Height. | Girth. | Year. | By whom measured. |
|---|---|---|---|---|
| Northerwood, Hants | 106 ft. | 14 ft. 6 in. | 1907 | H. J. Elwes. A very fine tree, painted by Mr. Short. |
| Dropmore, Bucks | 77 ft. | 15 ft. | 1909 | C. Page. |
| Bury Hill, Surrey | 98 ft. | 14 ft. 6 in. | 1908 | H. J. Elwes. |
| Deepdene, Surrey | 86 ft. | 9 ft. 2 in. | 1905 | A. Henry. |
| Goodwood, Sussex (Plate 283) | 83 ft. | 9 ft. | 1906 | H. J. Elwes. Very clean stem to 35 ft.; not spreading. |
| Beauport, Sussex | 90 ft. | 12 ft. 9 in. | 1905 | H. J. Elwes. Raised about 1855 from seed of tree by house. |
| Sandling Park, Kent | 85 ft. | 15 ft. 10 in. at 2½ ft. | 1907 | H. J. Elwes. Large branches coming off at 5 ft. |
| Cobham Hall, Kent | 90 ft. | 11 ft. 9 in. | 1906 | A. Henry. |
| Trebah, Cornwall | 95-100 ft. | 12 ft. 5 in. | 1909 | A. B. Jackson. |
| Essendon Place, Herts[1] | 69 ft. | 10 ft. | 1906 | H. Clinton Baker. |
| Fulmodestone, Norfolk | 70 ft. | 10 ft. 10 in. | 1905 | Sir Hugh Beevor. |
| Eastnor Castle, Herefordshire[2] | 80 ft. | 10½ ft. | 1909 | J. Mullins. |
| Bellshill, Northumberland | 55 ft. | 9 ft. | 1906 | H. J. Elwes. Healthy in this cold county three to four miles from the sea. |
| Stackpole Court, Pembrokeshire | 90 ft. | 9 ft. 9 in. | 1906 | H. J. Elwes. |
| Bodorgan, Anglesea | 75 ft. | 17 ft. at ground | 1906 | H. J. Elwes. Large branches come off at 5 ft.; 72 paces round. |

At Dropmore[3] trees from cuttings planted in 1839, treated exactly the same way as seedlings put out in the same year, were in 1882 somewhat smaller in height and in girth. At White Knights, Reading, a tree eighteen years old, from seed, measured in 1904, 52 ft. high by 4 ft. in girth. At Highnam Court, Gloucester, there are two trees, one with short leaves and small cones, which measured in 1906, 54 ft. by 8 ft. 4 in. The other, with much larger cones and larger leaves, was 56 ft. by 4 ft. 7 in. At Bicton a remarkable specimen, 75 ft. high and about 15 ft. in girth near the ground, dividing into many large branches higher up, was measured by me in 1902. A large tree at Longford Castle, planted in 1845 and growing on yellow loam close to the river Avon, in 1893 was 60 ft. high and 15½ ft. in girth at a foot from the ground, dividing above into eleven great branches.[4] Now it is about 65 ft. high and 75 ft. in diameter, perfectly healthy, and unhurt by frost. There are several fine trees at Osborne.

In Scotland this species was killed[5] in many places in the severe winter of 1860-1861; and has not thriven subsequently in other places, as it is a failure at Glamis Castle, Forfarshire, and at Murthly, Perthshire. At Hopetoun, Linlithgowshire, the best specimen was killed in 1860, and a survivor was so much injured by the frost of 1879-80 that it was cut down in 1881. Similarly in the north of England, at Lambton Park, Co. Durham, it has been repeatedly tried and failed.

The Monterey pine, however, thrives on the west coast of Scotland; and a tree planted at Monreith, Wigtownshire, in 1884 was 63 ft. high by 5 ft. in girth in 1908.

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[1] A tree at Essendon Place, perhaps the same as this, measured, in 1866, 50 ft. high by 2½ ft. in diameter, according to *Gard. Chron.* 1866, p. 950.

[2] *Gard. Chron.* ix. 108, fig. 23 (1878).

[3] Cf. Hutchison, in *Trans. Highland and Agric. Soc. Scotland*, xiv. 59 (1882). Mr. Frost expressed the opinion that cuttings of this pine throve as well as seedlings.

[4] *Gard. Chron.* xiv. 725 (1893).

[5] Cf. Hutchison, *op. cit.* 58.

At Castle Kennedy there are two trees, which girthed in 1904, 9 ft. 4 in. and 8 ft. 6 in., both being 68 ft. in height. At Bargaly, Kirkcudbright, a tree was 75 ft. by 11 ft. 8 in., in 1904. At Keir, Perthshire, there is a healthy tree, although it has never borne cones, which measured in 1905, 73 ft. by 11 ft.

This species thrives amazingly in most parts of Ireland. The finest specimens which we have seen are as follows:—

| | Height. | Girth. | Year. | By whom measured. |
|---|---|---|---|---|
| Woodstock, Kilkenny | 110 ft. | 12½ ft. | 1909 | H. J. Elwes. |
| „ „ | 90 ft. | 14½ ft. | 1909 | H. J. Elwes. |
| Curraghmore, Waterford[1] | 95 ft. | 13 ft. 3 in. | 1909 | H. J. Elwes. |
| „ „ | 98 ft. | 11 ft. 3 in. | 1909 | H. J. Elwes. |
| Fota, Cork | 90 ft. | 15 ft. 2 in. | 1908 | H. J. Elwes. An immense tree, 96 paces in circumference. |
| Muckross, Kerry (Plate 284) | 85 ft. | 14 ft. 10 in. | 1909 | H. J. Elwes. |
| Powerscourt, Wicklow[2] | 97 ft. | 11 ft. 5 in. | 1904 | A. Henry. Planted 1865. |
| Kilruddery, Wicklow | 82 ft. | 16 ft. | 1904 | A. Henry. |
| Charleville, Wicklow | 86 ft. | 11 ft. 9 in. | 1904 | A. Henry. |
| Mountshannon, Limerick[3] | 89 ft. | 15 ft. 2 in. | 1905 | A. Henry. |
| Adare, Limerick | 87 ft. | 6 ft. 10 in. | 1905 | A. Henry. A narrow, pyramidal tree. |
| Glenstal, Limerick | 91 ft. | 15 ft. | 1903 | A. Henry. |
| Clonbrock, Galway | 90 ft. | 12½ ft. | 1903 | A. Henry. Planted 1857. |
| Hamwood, Meath | 70 ft. | 17 ft. at ground | 1905 | A. Henry. Divided into four stems. |

The Monterey pine has been largely planted on the Pacific coast as far north as Washington, and as a rule has been successful. It thrives well near the coast at San Francisco; but requires careful watering in the arboretum of the Stanford University in the Santa Clara valley.

It has been largely planted of late years in South Africa, but is only climatically suited to the winter rainfall districts, and the wholesale planting of the tree in Natal and the Transvaal has produced disappointment.[4] According to Mr. J. S. Lister, Conservator of Forests, the average annual increment per acre of ten-year-old trees has been no less than 526 ft., as compared with 152 ft. for Blue Gum and 203 ft. for *Pinus Pinaster*. Lately the leaves have been injured by the larva of a moth, *Antheræa cytherea*.

In New Zealand,[6] no other tree approaches this species in rapidity of growth, and even should it be found that the timber is not of a durable kind, the rate at which it is produced will render it profitable to grow. Mr. T. W. Adams says that his experience of the wood grown in New Zealand satisfies him that it will prove valuable for many purposes.

In Madeira, as I am informed by Dr. Watney, it grows with extraordinary rapidity. A tree at Camacha, sown *in situ* in 1883, measured in 1907, 99 ft. high, and about 8 ft. in girth at the base. (H. J. E.)

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[1] Here trees about ten years old and 10 to 23 ft. in height were killed in the severe winter of 1879-80. Cf. Hutchison, *op. cit.* 64.

[2] Seedlings have been raised from home-grown seed at Powerscourt.

[3] This tree was reported, no doubt erroneously, by the gardener, H. Lynch, to have been 98 ft. high in 1878. Cf. *Gard. Chron.* xv. 21 (1894).

[4] Hutchins, in Flint and Gilchrist, *Science in South Africa*, 396 (1905).

[5] In *Agric. Journ. Cape of Good Hope*, xxii. 447 (1903), and in *Rep. Conserv. Forests*, 1899, p. 93, *app.* N.

[6] Adams, *loc. cit.*

## PINUS PATULA, Mexican Pine

*Pinus patula*, Schlechtendal et Chamisso, in *Linnæa*, vi. 354 (1831), and xii. 488 (1838); Lambert, *Genus Pinus*, i. 36, t. 19 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2266 (1838); Masters, in *Gard. Chron.* xxiii. 108, tt. 20, 22 (1885), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 598 (1904); Kent, Veitch's *Man. Conif.* 355 (1900); Clinton-Baker, *Illust. Conif.* i. 41 (1909); Shaw, *Pines of Mexico*, 29, t. xxii. (1909).

A tree, attaining 80 ft. in height. Bark towards the base fissured longitudinally into large scaly plates; higher up thin, papery, reddish brown, and scaling off similarly to that of *P. sylvestris*. Young branchlets glabrous, glaucous, with slightly raised pulvini, becoming reddish brown in the second year. Buds cylindric-conic, acuminate, ½ in. to ¾ in. long; scales brown, interlaced by their white marginal fimbriæ, with apices free and directed upwards or spreading.

Leaves in threes, persistent two to four years, very filiform and slender, 6 to 9 in. long, $\frac{1}{25}$ in. or less in width, flexible, bent, pendulous, serrulate, ending in a cartilaginous point, marked with stomatic lines on the three sides; resin-canals median; basal sheath about an inch long.

Cones lateral, in clusters of two to five, on stout short scaly stalks, deflexed, ovoid-conic, slightly curved, oblique at the base, about 3 to 4 in. long, pale brown, shining; scales oblong, thin, ⅞ in. long, ½ in. wide; apophysis rhomboidal, with upper margin rounded, and a slightly elevated linear ridge; umbo dark grey, depressed, with a minute or obsolete prickle. Seed triangular, grey mottled with black, ⅙ in. long; wing ½ in. to ¾ in. long.

Cones are borne freely on cultivated trees in Cornwall and the south of Ireland, and apparently contain good seed, though we have not heard of any seedlings being raised. These cones remain closed on the old branches for seven or eight years, as they also do on native trees in Mexico.

This species is easily recognisable by its bark, peeling off in the upper part of the stem like *P. densiflora* and *P. sylvestris*, its very slender filiform long needles, multinodal glaucous reddish branchlets, and buds with scales free at the points.

This species, according to Shaw, attains 40 to 50 ft. in height, and grows, in company with *P. Teocote*, at warm temperate altitudes in the central and eastern states of Mexico. Near Jalapa it occurs at 7000 to 8000 ft., mixed with *P. Montezumæ* and various species of oak. Hartweg found it in the mountains around Real del Monte at 9700 ft. Stahl, in Karsten and Schenk, *Vegetationsbilder*, ii. pl. 13 (1905), figures a wood of this species under the Vigas, about 7000 ft. above sea-level, on the road from Perote to Jalapa.

This species was discovered by Schiede and Deppe in 1828, and was probably introduced by them, as Lambert, according to Loudon, had a plant 6 ft. high at Boyton in 1837. Hartweg collected seeds in 1838 from which plants were raised in the garden of the Horticultural Society. (A. H.)

This species succeeds in the mild climate of the south-west of England as in

Cornwall, and of the south of Ireland, where there are many fine specimens. One at Carclew (Plate 285) measured, in 1908, 61 ft. in height and 6 ft. 3 in. in girth. At Luscombe Castle, Dawlish, a tree 55 ft. by 6 ft. 3 in. was bearing cones abundantly when I saw it in 1908. At Tregrehan, a tree,[1] 42 ft. by 8 ft. in 1898, was 60 yards round the branches. At Bicton, Mr. A. B. Jackson measured in 1908 a tree 48 ft. high, dividing at 2 ft. from the ground into two stems, 5 ft. 11 in., and 7 ft. 5 in. in girth. At Pencarrow, Lamorran, and Menabilly, I have seen other specimens of less dimensions. At Fota, near Queenstown, a branchy tree, with a short bole of 8 ft. dividing into wide-spreading limbs, measured in 1908, 63 ft. high by 11 ft. in girth. Many of the branches had been broken by previous gales. This tree was planted in 1847. (H. J. E.)

## PINUS TEOCOTE

*Pinus Teocote*,[2] Schlechtendal et Chamisso, in *Linnæa*, v. 76 (1830); Lambert, *Genus Pinus*, i. 37, t. 20 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2266 (1838), and *Encycl. Trees*, 991 (1842); Kent, Veitch's *Man. Conif.* 356 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 598 (1904); Shaw, *Pines of Mexico*, 16, t. ix. (1909).

A tree, attaining 90 ft. high in Mexico, with bark fissured into scaly plates. Young branchlets glabrous, glaucous, pale brown; the epidermis of the decurrent pulvini peeling off in the second and third year. Buds cylindric-conic, obtuse, about ¾ in. long, resinous; scales with tips free, interlaced at their bases by white marginal fimbriæ.

Leaves in threes, persistent three years, 4 to 8 in. long, $\frac{1}{20}$ in. broad, spreading, rigid, sharp-pointed, serrulate, with stomatic lines on the three surfaces; resin-canals median; basal sheath about an inch long.

Cones sub-terminal, rarely lateral, single or in pairs, spreading or reflexed, short-stalked, opening when ripe, and falling soon afterwards, ovoid-cylindrical, about 2¼ in. long, dull brown or slightly shining; scales numerous, ¾ in. long, ⅓ in. broad; apophysis thickened at the margin, slightly raised, transversely ridged; umbo usually depressed and ashy-grey, with a minute, straight, often obsolete prickle. Seed small, with a narrow wing.

Var. *macrocarpa*, Shaw, *Pines of Mexico*, 17, t. x. (1909).

*Pinus leiophylla*, Bentham, *Pl. Hartw.* 58 (1842) (in part).

Leaves in threes, fours, or fives. Cones considerably larger than in the type, and illustrated by Lambert's plate. Recorded from a few localities in Mexico, Chiapas, and Tlaxcala.

*P. Teocote*, according to Shaw, grows at temperate altitudes in the southern, central, western, and north-western Sierras of Mexico, associated with *P. leiophylla*,

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[1] This tree is figured in *Gard. Chron.* xxiii. 108, fig. 22 (1885). Fig. 20 represents a cone from a Carclew tree. Three trees are mentioned as existing at Carclew in 1885, measuring 30 ft. by 6 ft., 40 ft. by 6½ ft., and 30 ft. by 5 ft., the girths being taken at three feet from the ground. One of these has since been destroyed by lightning. The dimensions of other trees in 1885 were:—Lamorran, 24½ ft. by 3 ft. 10 in.; Pencarrow, 43 ft. by 7 ft. 3 in.; and Bicton, 36 ft. in height.

[2] According to Shaw, the word "ocote," from which the tree derives its name, signifies in Mexico, pitch pines and their products. Small bundles of firewood offered for sale in the markets of the cities are also called "ocote."

Schiede and Deppe. It grows on the high lands, particularly on the sloping sides of the mountains of Orizaba and Real del Monte. It is also plentiful in Oaxaca,[1] at 9000 ft. elevation, on dry, hard, and poor soil, composed of reddish clay, where it is a slender tree, of moderate size, with hard and resinous reddish wood.

According to Loudon, a single plant was in cultivation at Boyton in 1826. Subsequently, in 1839, cones were sent by Hartweg to the Horticultural Society of London, who distributed the seed, from which many plants were raised. Most of these succumbed in severe winters; and only a few trees are now living in this country. There are two at Bicton, one[2] of which, measured by Mr. H. Clinton-Baker in 1898, is 60 ft. by 5 ft. 9 in.; the other is 57 ft. by 6 ft. 10 in. At Luscombe Castle, another is about 50 ft. high by 5 ft. 4 in. in girth. A small tree also exists at Fota, which I saw in 1907. (A. H.)

## PINUS RIGIDA, NORTHERN PITCH PINE

*Pinus rigida*, Miller, *Dict.* ed. 8, No. 10 (1768); Loudon, *Arb. et Frut. Brit.* iv. 2239 (1838); Sargent, *Silva N. Amer.* xi. 115, t. 579 (1897), and *Trees N. Amer.* 20 (1905); Kent, Veitch's *Man. Coniferæ*, 373 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 599 (1904); Mayr, *Fremdländ. Wald- u. Parkbäume*, 361 (1906); Clinton-Baker, *Illust. Conif.* i. 49 (1909); Bean, in *Gard. Chron.* xlv. 178, fig. 75 (1909).

*Pinus Taeda*, Linnæus, var. *rigida*, Aiton, *Hort. Kew*, iii. 368 (1789).

*Pinus Taeda*, Linnæus, var. *A*, Poiret, in Lamarck, *Dict.* v. 340 (1803).

A tree, attaining in America 80 ft. in height and 9 ft. in girth. Bark on young stems thin and broken into reddish brown scales, on old trunks an inch thick and deeply and irregularly fissured into broad flat scaly ridges. Young branchlets glabrous, reddish brown, with prominent keeled pulvini. Buds cylindrical or conical, sharp-pointed, ½ to ¾ in. long; scales interlaced and matted together by their white fimbriated edges, their long acuminate brown apices free and spreading.

Leaves in threes, persistent two years, spreading, 3½ to 4½ in. long, rigid, slightly curved and twisted, serrulate, ending in a callous point, marked on the three faces by numerous stomatic lines; resin-canals median; basal sheath ⅜ to ½ in. long.

Cones lateral, usually clustered, sub-sessile, spreading, variable in size, averaging 2½ in. in length, ovoid, light brown, symmetrical at the base; scales thin, flat, ⅞ in. long, ⅜ in. wide; apophysis shining, rhomboidal, with a raised sharp transverse keel, and an elevated dark-coloured umbo, terminating in a recurved slender prickle. Seed triangular, with a blackish roughened shell, and a pale brown wing, broadest below the middle; seed with wing about ¾ in. long. Cotyledons five. The cones often persist on the branches, and even on the stem, for many years, many opening when ripe and letting out the seed, others remaining closed for an indefinite period. Cones are freely produced on very young trees.

This species is remarkable amongst pines for the frequent occurrence on untouched old stems of adventitious buds, which usually produce branchlets, the shortest of these resembling tufts of leaves arising from the bark, the largest attaining a few inches in length and branching. Carrière[1] records an instance where clusters of staminate flowers, without any foliage, issued from the trunk of a tree of this species.

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[1] Cf. *Garden and Forest*, ix. 102 (1896).

[2] This tree was labelled *P. oocarpa*. The other was named correctly *P. Teocote*.

In New Jersey,[2] after the destruction of the trees by fires or by felling, sprouts arise from the stumps, which grow to a considerable size, 6 to 8 in. in diameter; and suckers also spring from the roots, giving rise to a dense bush-like growth. At Grafrath,[3] near Munich, only 4 per cent of a number of trees, broken by snow, gave stool-shoots, most of which were short-lived. Similarly, at Les Barres, numerous stool-shoots were produced from the stumps of felled trees, but M. Pardé[4] believes that these will never make trees. This faculty of regeneration by coppice shoots, so rare amongst conifers, appears in this case to be of no economic value.

## DISTRIBUTION

This species is the one always known in eastern North America as the pitch pine, though having nothing in common with the pitch pine of commerce (*P. palustris*). It is widely distributed, crossing the northern boundary of the United States, as far north as the valley of the St. John River in southern New Brunswick, the north shore of Lake Ontario, and the valley of the lower Ottawa river; extending southward in the Atlantic States from Franklin County, Maine, where it is a mere shrub, to northern Georgia, and crossing the Alleghany Mountains to their western foot-hills in eastern Ohio, Pennsylvania, West Virginia, Kentucky, and Tennessee. It is common in the New England states, often forming extensive forests, and grows mainly on sandy plains and dry gravelly slopes, though occasionally it is seen in swamps. In New Hampshire, where I saw this species, the greater part of the land on which it occurs has been repeatedly burnt over;[5] and it appears to be adapted for regeneration after forest fires, as, like *P. Banksiana*, it produces cones freely and at an early age; and a considerable percentage of the cones hold the seed for several years. Near Hinsdale, it grows in pure open woods on poor sand, the trees scarcely ever exceeding 60 ft. in height and 4 ft. in girth; but in slightly better soil, where the sand contained the mould of decayed leaves, *P. Strobus* grows with it in mixture, and will eventually suppress it, owing to the taller growth of the Weymouth pine.

Sargent[6] gives an account of a pure forest of the species in Ocean County, New Jersey, which occupies land that had been farmed fifty years previously. An illustration shows a forest of crowded small slender trees about 50 ft. in height. According to Prof. Cooke,[7] it is one of the most profitable trees to plant in this state, where, after thirty years, it yields a net profit averaging $15 per acre. Owing to the facility with which it can be raised by sowing[1] on the poorest soil, it has lately been planted in barren tracts on the coast of Massachusetts and New Jersey, for the production of firewood, though old houses timbered and floored a hundred years ago with this wood, grown on better soil, are still in a good state of preservation. Grown singly, it assumes a ragged appearance, as is well shown in a picture of a wind-swept specimen given in *Garden and Forest*, iv. 397, fig. 65 (1891). (A. H.)

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[1] *Conif.* 448 (1867).

[2] *Garden and Forest*, viii. 472 (1895), and x. 192, fig. 24 (1897), the figure showing new growth after the destruction of all the foliage by fire.

[3] Mayr, *Fremdländ. Wald- u. Parkbäume*, 363, fig. 116 (1906), the figure showing a burnt tree with numerous adventitious shoots on the stem.

[4] *Principaux Végét. Ligneux Exotiques*, 37. Mr. T. W. Adams, in a paper read 7th August 1907, at the Philosophical Institute, Canterbury, New Zealand, says:—"Trees nearly a foot in diameter, which I cut down in thinning a plantation, sent out leaves along the trunk, while lying on the ground, as some broad-leaved trees do."

[5] Cf. Chittenden, *U.S. Forestry Bulletin*, No. 55, p. 55 (1905).

[6] *Garden and Forest*, i. 166 (1888).

[7] *Ibid.* 59.

### CULTIVATION

According to Aiton, it was in cultivation at Woburn before 1759; but though it grows better and lives longer than any of the eastern American pines, except *P. Strobus*, it has never become common, and has no qualities which make it desirable to cultivate in this country, except in botanic gardens and collections of conifers. It is hardy, and often ripens seed in the south of England; and as it grows well on the seashore and does not object to salt in the soil, it might be planted on barren sandy shores, though it might not be so suitable for this purpose as *P. radiata* or *P. austriaca*. It has been tried as a forest tree in Germany, where it was at first believed to be the species which produced the pitch pine of commerce, but has not shown any promise of success.[2] In France, according to M. M. de Vilmorin,[3] it is only fit for firewood and of no economic importance, though it might be tried on sandy soils in localities too cold for *P. Pinaster*.

I saw trees at Baleine, near Moulins, and at Geneste and Catros, near Bordeaux, of considerable age, but of no great size, which seems to prove that a warmer climate does not favour its development.

In the Hertogenwald, in Belgium, about fifty trees[4] of this species, planted in mixture with the common pine at 1500 ft. elevation, on poor soil, at fifty-five years old, average 48 ft. high, and, though healthy and bearing cones, show no advantage in this situation over *P. sylvestris*.

Forbes states that there were several trees of this species believed by him to have been planted in 1743 in the evergreens at Woburn in 1839, one of which measured 75 ft. high and 11 ft. in girth; but I could hear of none now living.

The largest tree, which we have seen or heard of, is growing at Dropmore, and in 1909 was 84 ft. high by 7 ft. 8 in. in girth. It was probably planted in 1847. There are three good trees at Arley Castle, two of which, represented in Plate 286, measured in 1904, 69 ft. and 66 ft. in height, both being 7 ft. 2 in. in girth. The third is 66 ft. high by 5 ft. 11 in. in girth. A tree in Mr. Kaufmann's grounds, The Wilderness, White Knights, measured in 1904, 48 ft. by 8 ft. 1 in., and has thrown out from the stem numerous small adventitious branchlets. Mr. A. B. Jackson measured in 1909 a tree at Bury Hill, Dorking, 56 ft. by 4 ft. Another at Essendon Place, Herts, measured 45 ft. by 6½ ft. in 1908. There are also smaller specimens in Kew Gardens, where most of the trees of the species show similar adventitious branchlets; at Nuneham Park, Beauport, Bayfordbury, and Tortworth. A tree at Bargally, in Kirkcudbright, measured 42 ft. by 4 ft. 1 in. in 1904. Trees at Coollattin, Wicklow, about 30 ft. high, are very thriving.

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[1] It is sown broadcast or in shallow drills. No other conifer grows so rapidly in New England on dry sterile gravels. Cf. Sargent, in *Garden and Forest*, x. 470 (1897).

[2] Cf. Mayr, *op. cit.*; Schwappach, *Anbauversuche fremdländ. Holzarten*, 58 (1901); and Unwin, *Future Forest Trees*, 49, 86 (1905).

[3] *Garden and Forest*, x. 113 (1897).

[4] Seen by Henry in 1908.

### TIMBER

The wood[1] of this pine is little valued in its own country except for firewood, being light, soft, and brittle; and so far as I know is never exported. It contains large quantities of resin; and a century ago was of some economic importance in the production of tar and turpentine, though when the pitch pine of the south became more generally known, it was superseded by the abundant supplies yielded by that tree. (H. J. E.)

## PINUS SEROTINA, POND PINE

*Pinus serotina*, Michaux, *Fl. Bor. Amer.* ii. 205 (1803); Sargent, *Silva N. Amer.* xi. 119, t. 580 (1897), and *Trees N. Amer.* 20 (1905); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 599 (1904); Clinton-Baker, *Illust. Conif.* i. 51 (1909).

*Pinus rigida*, Miller, var. *serotina*, Loudon, *Arb. et Frut. Brit.* iv. 2242 (1838); Engelmann, in *Trans. St. Louis Acad. Science*, iv. 183 (1880); Kent, Veitch's *Man. Conif.* 374 (1900).

This species, which is probably only a southern geographical variety of *P. rigida*, is distinguished from the latter by its more resinous buds, and by its longer leaves, usually 6 to 7, rarely 8 to 10 in. long. The cones are variable in shape, either sub-globose or shortly ovoid, or elongated conical, 2 to 3 in. in length, similar in position and colour to *P. rigida*, but with the more slender prickles usually deciduous. The cones, moreover, as a rule, remain closed on the tree for several years before opening and letting out their seeds. Adventitious branches are produced on old trunks.[2]

The pond pine grows in low wet flats or in sandy or peaty swamps, near the Atlantic coast from Albemarle Sound southward to the head of St. John's river in Florida, and occurs also, according to Roth,[3] on the west side of the peninsula of Florida, and along the Gulf of Mexico westward to near Pensacola. In its manner of growth it resembles *P. Tæda*, and produces similar timber, and is occasionally[4] tapped for turpentine. It is generally found, either mixed with *P. Tæda* or with *P. Caribæa*, occasionally associating in North Carolina with broad-leaved trees, and is rarely seen in considerable quantity. It often takes possession of abandoned fields.

This species was introduced in 1713, according to Loudon,[5] who mentions trees about 30 ft. high, at Dropmore, Syon, Pains Hill, and Kenwood. It is probably short-lived in our climate, where it bears shorter foliage than in America; and the only trees we have been able to identify, are one at Bicton,[1] which was 53 ft. by 4 ft. 8 in. in 1908; and another at Bayfordbury, in an unhealthy state, measuring 41 ft. in height, and 5 ft. 7 in. in girth. This was planted in 1842. (A. H.)

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[1] Hough, *Trees N. States and Canada*, 9 (1907), says the wood is of medium weight and hardness, with coarse conspicuous grain, resinous and of a brownish red colour with abundant lighter sapwood. It is used for coarse lumber, flooring, sills, etc.; and to some extent for fuel and charcoal.

[2] Cf. *Garden and Forest*, x. 209 (1897). Engelmann, *loc. cit.*, states that felled trees or posts set in the ground sometimes produce sprouts bearing primary leaves.

[3] In *U.S. Forestry Bulletin* No. 13, p. 169 (1897).

[4] According to Sargent, in *Trees N. Amer.* 21 (1905), but it is not mentioned by Mohr, and must be done on a very small scale.

[5] *Ency. Trees and Shrubs*, 979 (1842).

## PINUS PALUSTRIS, LONG-LEAF PINE, PITCH PINE

*Pinus palustris*, Miller, *Dict.* ed. viii. No. 14 (1768); Sargent, *Silva N. Amer.* xi. 151, tt. 589, 590, (1897), and *Trees N. Amer.* 17 (1905); Kent, Veitch's *Man. Coniferæ*, 352 (1900); Masters in *Journ. Linn. Soc.* (*Bot.*) xxxv. 604 (1904); Clinton-Baker, *Illust. Conif.* i. 38 (1909).

*Pinus lutea*, Walter, *Fl. Carol.* 237 (1788).

*Pinus longifolia*, Salisbury, *Prod.* 398 (1796).

*Pinus australis*, Michaux, *Hist. Arb. Amer.* i. 64, t. 6 (1810); Loudon, *Arb. et Frut. Brit.* iv. 2255 (1838)

A tree, attaining in America 120 ft. in height and 9 ft. in girth. Bark thin, dark, scaly. Young branchlets thick, orange-brown, much roughened by the numerous prominent pulvini. Buds non-resinous, cylindrical, pointed, 1½ in. to 2 in. long; scales lanceolate-acuminate, silvery white, interlaced by their white marginal fimbriæ and with their apices free and reflexed. These persist as a dense sheath of reflexed bud-scales at the apex of the branchlet of the second year.

Leaves in threes, deciduous at the end of the second year, about 8 in. long on old trees, 9 to 18 in. long on young vigorous trees, densely crowded on the branchlets, slender, flexible, serrulate, ending in a cartilaginous point, with stomatic lines on all three sides; resin-canals median; basal sheath ¾ in. to 1 in. long.

Cones sub-terminal, spreading or pendulous, on short stout scaly stalks, cylindric-conic, slightly curved, 5 to 8 in. long; scales thin, flat, 2 in. long, ¾ in. wide; apophysis rhomboidal, slightly elevated, crenate in upper margin, with a transverse sharp ridge, and projecting umbo, armed with a small reflexed prickle. Seed triangular-oval, rather less than ½ in. long, inner surface whitish and three-ridged, outer surface dark-spotted; wing narrow, 1½ in. long. The seeds are shed during dry weather in autumn; and occasionally, when wet sultry weather sets in late, begin to sprout in the cones. The cones usually fall, after dehiscence of the seeds, in the latter part of the winter of the second year, leaving as a rule the lowest rows of scales attached to the branch.

(A. H.)

This[2] is perhaps of all the pines of North America the one which formerly existed in greatest abundance, throughout a wide belt of country from Virginia through the Carolinas, Georgia, Alabama and Florida, where it extends south to Tampa bay, west to the valley of the Trinity river in Texas, and up the Mississippi valley to the northern borders of Louisiana. It is mainly confined to low-lying tertiary sands and gravels; but Mohr[3] found it in Talladega county, Alabama, up to

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[1] This tree has long been labelled erroneously "*P. resinosa.*"

[2] A complete account of this pine is given by Mohr in *U.S. Forestry Bulletin*, No. 13, pp. 29-75 (1897). Cf. also G. F. Schwarz, *The Longleaf Pine in Virgin Forest*, pp. 135, 23 illustrations (1907).

[3] Mohr, *op. cit.* p. 73.

2000 ft. above the sea. It averages about 100 ft. in height, and occasionally reaches 120 ft., girthing 6 ft. to 8 ft.; and grows usually in pure forests, but near the limits of its area is mixed with other trees.

No tree has suffered so much at the hand of man as the pitch pine. When I first passed through the southern States in 1888 it formed an almost unbroken forest for hundreds of miles along the railway, but is now diminishing so rapidly, that to use Sargent's words, "it seems hopelessly doomed to lose its commercial importance at no distant day."

The literature of this species is very voluminous, and has been largely quoted by Sargent and Loudon; but as it seems impossible to cultivate in this country, we need not say much about it, except that it has been repeatedly tried since 1730 and has usually failed to grow[1] for more than a few years. However, a tree of about 12 ft. high exists in a stunted state at Kew; and another similar in size and unhealthy was seen by Mr. H. Clinton-Baker in 1908 at Menabilly, Cornwall. A seedling raised at Steventon and planted in the Tubney arboretum near Oxford, survived about 25° of frost in the winter of 1908-9.

In France *P. palustris*[2] has been grown successfully in one place at least, as we learn from an article[3] by M. Maurice de Vilmorin, who gives an excellent photograph of two trees at Geneste, near Bordeaux, which were sown in 1831, and are the only survivors of seventeen. In 1897 the largest was 18 metres high by 1·70 metre in girth, the other 16 metres by 1·50 metre. Near them was a Loblolly pine, whose volume was said to be twice as great, though no dimensions were mentioned. They grow on the edge of the dunes near the sea, and M. de Vilmorin states that as producers of timber they cannot in that region compare with *P. Pinaster*, which is mature at forty years old. I visited Geneste, the property of Mlle. Ivoy, in April 1909, and measured these trees carefully. The two largest are 68 ft. by 6 ft. 3 in., and 59 ft. by 5 ft. They seem perfectly healthy, but bear no cones. As the temperature in occasional severe winters, as in 1893, descends at Bordeaux to − 16° Cent., it seems as though the want of sufficient heat in summer is the reason why this tree will not grow in England. I believe that on the coast of Portugal it would succeed well.

On the banks of Lago Maggiore, however, in the garden of Rovelli Frères, there is a pitch pine with a clean trunk measuring about 60 ft. by 5½ ft.; and at Intra, in the grounds of the Villa Barbot, I measured a still finer tree, about 75 ft. by 7 ft.

Though the import of the timber of this species to Europe has only assumed great importance in the last twenty years, it is now shipped in larger quantity than any other American timber. Marshall Ward[4] identified the pitch pine of commerce with *P. rigida*, which it certainly is not; but Laslett himself was evidently writing of the true pitch pine, which he said came chiefly from the ports of Savannah, Darien, and Pensacola, where *P. rigida* is not found. He says it was much used for masts in shipbuilding, and in architecture wherever long, straight, and large scantlings were needed; and gives details of experiments on its strength and elasticity made for the Admiralty.

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[1] Webster in *Hardy Coniferous Trees*, 95 (1896), says a few specimens have done well at Penrhyn and Woburn. There are no trees of this species at either place, the tree named *P. australis* at Penrhyn being *P. ponderosa*.

[2] According to *Ann. Hort. Paris*, xix. 212, quoted by Loudon, *Gard. Mag.* xv. 236 (1839), the species may be grafted on *P. Laricio*, and is then rendered much hardier.

[3] *Garden and Forest*, x. 112 (1897).

[4] Laslett, *Timber and Timber Trees*, 367 (1894).

Sargent describes the timber as exceedingly hard, very strong, tough-grained, and durable, of light red or orange colour, with nearly white sap-wood. In the United States it is preferred to any other wood for the construction of railway cars, and is now in great demand for railway sleepers, which are replacing those made of oak and chestnut in the northern states.

In consequence of the large consumption in America, and of the great quantity of trees destroyed for resin and by fire, the price has lately risen very much in the English market, being in February 1906 as much as 1s. 6d. to 2s. per cubic foot; and for very long squared balks a higher price is obtained.

Mr. Weale writes as follows:—"The heaviest of the American pines; principally exported from Pensacola and Mobile. It contains resin in quantity, which makes it very durable, and permits its employment in exposed situations. Is moderately hard and straight-grained, and being easily obtainable in long lengths, is in demand for bridge and pier work, and as a building timber. The wood is frequently figured, and used for panelling. For school fittings and furniture, church pews and seatings, it is eminently suitable. In America it is in request for railway sleepers and mining timber, but the low prices at which the Baltic goods are imported prevents its use for the latter purposes in this country."

A handsomely marked variety of this wood, known as curly pitch pine, is found on the outside of some logs, which, when polished, has a nice effect in panels, and being cheap and easy to match, is oftener used in England than the more beautiful, though softer, curly redwood, a variety of the wood of *Sequoia sempervirens.*

Pinchot[1] states that in the Government statistics, under the heading "Yellow Pine," are grouped all the reports of pine production in the south and west, except those of white pine (*P. Strobus*) and Norway pine (*P. resinosa*). Several species, such as *P. palustris*, *P. Tæda*, *P. caribæa*, *P. echinata*, and *P. rigida*, enter into this total. Most of the lumber cut in Texas, Louisiana, Mississippi, Alabama, Georgia, and Florida is *P. palustris*; while practically all that of Arkansas and Missouri is *P. echinata.* Most of the pine cut in Virginia and North and South Carolina is *P. Tæda.*

The resin[2] or crude turpentine obtained by tapping *P. palustris*, and to a lesser extent *P. caribæa*,[3] furnishes the raw material for the production of resin and spirits of turpentine. At present these two species furnish the great bulk of the supply for the whole world. France and Austria, the only other countries where resin is produced on a considerable scale, account for perhaps one-tenth of the total produce. In 1907 the total export of resin from the eastern states was 2½ million barrels, valued at $11,000,000; while that of spirits of turpentine amounted to 16 million gallons, valued at $10,000,000. Judging from the statistics,[1] the annual production is stationary, but the price has increased enormously since 1903. *P. rigida* was tapped for resin in the colonial days in the northern States.

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[1] *U.S. Forestry Bull.* 77, p. 18 (1906).

[2] This industry is known in America as turpentine orcharding, and is well described by Ashe in *N. Carolina Geol. Survey Bull.* No. 5 (1894); by Mohr, *op. cit.* 67 (1897); and by Bastin and Trimble, *N. Amer. Coniferæ*, 48 (1897).

[3] *P. serotina* is occasionally tapped in the coast region of North Carolina. *P. Tæda* is never tapped. See our remarks under these species.

Pine-wool,[2] used in the manufacture of carpets and mats, is prepared from the leaves of this species. (H. J. E.)

## PINUS TÆDA, Loblolly Pine

*Pinus Tæda*; Linnæus, *Sp. Pl.* 1000 (1753); Lambert, *Genus Pinus*, i. 14, t. 15 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2237 (1838); Forbes, *Pin. Woburnense*, 43, t. 14 (1839); Sargent, *Silva N. Amer.* xi. 111, tt. 577, 578 (1897), and *Trees N. Amer.* 19 (1905); Mohr and Roth, *U.S. Forestry Bulletin* No. 13, p. 113, tt. 17-20 (1897); Kent, Veitch's *Man. Conif.* 382 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 598 (1904); Clinton-Baker, *Illust. Conif.* i. 54 (1909).

A tree, 80 to 100 ft. high, with a straight trunk, usually 6 ft., occasionally 15 ft. in girth. Bark about an inch thick, reddish brown, divided by shallow fissures into broad flat scaly ridges. Young branches glabrous, glaucous, becoming yellowish brown, roughened by the raised and imbricated pulvini. Buds conic, about ½ in. long; scales brown, matted together by their white marginal fimbriæ, and with their apices free and reflexed.

Leaves in threes, persistent for three years, densely crowded, spreading, 6 to 9 in. long, $\frac{1}{16}$ in. wide, rigid, slightly twisted, serrulate, ending in a sharp cartilaginous point, pale green, with numerous stomatic lines on the three sides; resin-canals median; basal sheath nearly an inch in length. The reflexed bud-scales remain as a persistent sheath at the apex of the shoots of the second and third years.

Cones lateral,[3] solitary or clustered, sub-sessile, spreading, cylindric-conic, usually 3 in. long, occasionally 4 or 5 in., light brown; scales thin, about an inch long and ½ in. wide; apophysis rhomboidal, raised, with a transverse elevated ridge, and a triangular umbo, ending in a short, usually reflexed prickle. Seed rhomboid, ¼ in. long, with two or three distinct ridges, dark brown mottled with black, surrounded to the base by the narrow border of the delicate wing, which is pale brown, shining, and about an inch long. Cones are produced abundantly every year, opening in autumn and winter of the second year, and falling off in the succeeding season through the decay of their short stalks. The seedlings have usually six cotyledons, and grow fast, producing adult ternate leaves in their first season, when they attain 6 to 8 in. in height. They average in the forest at the end of the fourth year 3 ft. in height.

The Loblolly pine extends along the coast from Cape May in New Jersey, and the Delaware and Maryland peninsula, southwards to Cape Malabar and Tampa Bay in Florida, and westward to near New Orleans, extending inland as far northward as the parallel of 35°, occupying large tracts in the Carolinas, Georgia, Alabama, and Mississippi, extending into southern Tennessee. West of the Mississippi river it occurs as far north as the south-eastern border of Indian Territory and southern Arkansas, where it frequently grows in extensive nearly pure forests on the rolling uplands, and occurs in Louisiana and eastern Texas as far west as the valley of the Colorado river.

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[1] Pinchot, *U.S. Forest Circular* No. 153 (1908).

[2] Cf. J. R. Jackson, in *Gard. Chron.* xliv. 366 (1908), who states that pine-wool is also prepared in Breslau, Silesia, from the leaves of the Austrian pine (*P. Laricio*, var. *austriaca*). The latter is used for stuffing cushions, and is made, mixed with ordinary wool, into a kind of flannel. Specimens of both kinds may be seen in the Kew museum.

[3] They are subterminal in badly-developed trees.

On the Atlantic slope, near its northern limit, it grows most frequently on the flat lands of the tidewater districts, usually crowded with other pines, oaks, and hickories; and in Virginia and North Carolina springs up rapidly on lands exhausted by agriculture, the primeval forests having nearly all disappeared. In the swamps bordering the Albemarle and Pimlico sounds, gigantic trees of this species, known as the Rosemary pine, sometimes attained[1] a height of 170 ft.

In Berkeley county, South Carolina, the forest land[2] consists of four distinct regions. On the fresh and moist uplands, where the soil is a light sandy loam, *P. Tæda* occurs both in pure stands or in mixture with *P. palustris* and broad-leaved trees. *P. palustris* is confined mainly to the higher situations and the drier and lighter soils, either pure or mixed with *P. Tæda* and hardwoods. In the alluvial land, either along rivers or bordering swamps, where the soil is best, the forest is mixed, consisting of maple, ash, hickory, oaks, with *P. Tæda* and *P. serotina.* In the swamps, where there is standing water all the year round, there is the same admixture of species, with the addition of *Taxodium distichum.* (A. H.)

This pine is of considerable economic importance in the southern and south-western states, where it forms considerable forests; and though there are no reliable statistics, it appears to be one of the main trees cut for lumber at the present time in Virginia and the Carolinas.[3] A considerable proportion of the long and heavy sticks of hewn timber reaching the Mobile market from Alabama for export as "pitch pine" are Loblolly pine.[4] Half the lumber cut in Arkansas and shipped as "yellow pine" to northern markets is Loblolly pine, the other half being *P. echinata.* The timber is very variable in quality under different conditions of growth. Sargent says that very large and fine masts were formerly made of this tree, and used in the United States as well as shipped to Europe; but were not distinguished by Laslett from those made of *P. Strobus.*

In England this tree has been grown for nearly two centuries, having been introduced[5] by Bishop Compton before 1713, but though it has attained a considerable size in some instances, it cannot be said to thrive in this country, requiring a much greater degree of heat than our climate affords.

Loudon figures a tree 75 ft. high, growing at Syon in 1838, and mentions others at Kew, Dropmore, Whitton, and Pains Hill, the latter being then 60 to 70 ft. high, and, as he said, the handsomest tree in Europe. All these are now dead, and the only tree[1] which we have found is one growing at Bicton which Mr. H. Clinton-Baker measured in 1908, as 50 ft. in height, and 6 ft. 9 in. in girth at 3 ft. from the ground. This tree bears cones;[2] but the seed does not seem to be fertile. The leaves are $4\frac{1}{2}$ to 5 in. in length, much shorter than is usual in American trees of this species.

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[1] Cf. Curtis, *Trees and Shrubs, N. Carolina*, 23 (1860).

[2] Cf. Chapman, in *U.S. Forestry Bulletin* 56, pp. 8-10 (1905).

[3] Pinchot, in *U.S. Forestry Bulletin* 77, p. 18 (1906), says:—Most of the pine cut in Virginia and North and South Carolina is *P. Tæda*, which is widely known in commerce in the United States as North Carolina pine.

[4] Mohr says the best qualities are equal to true pitch pine, and are used by house carpenters. Large amounts of inferior stuff are shipped as firewood from the coasts of Virginia and North Carolina.

[5] Aiton, *Hort. Kew.* iii. 368 (1789).

At Geneste, near Bordeaux, I saw several large trees of this pine in 1909 growing near the pitch pines, which they much exceeded in size. The largest was 92 ft. by $9\frac{1}{2}$ ft., and bore abundant cones, which produce fertile seed, and natural reproduction is here common. Another was 95 ft. by 9 ft., a third about 85 ft. by $9\frac{1}{2}$ ft. Mademoiselle Ivoy informed me that the resin of this tree was much more aromatic than that of the native *P. Pinaster.*

Mr. Weale sends us the following note:—"Loblolly pine is not imported into this country in steady quantities and is often sold as Carolina pine. When pitch pine is imported in the form of sawn boards, this wood is frequently observed amongst them. It is not comparable with pitch pine in strength and durability, and cannot hope to find a market upon any other considerations than those of price."

Though the wood of this species contains but little less resin than that of *P. palustris*, and the composition and the distribution of the resin in the log are the same in both species, yet for some unexplained reason the resin of the Loblolly pine does not flow freely, and hardens so rapidly on exposure that it cannot be worked. The statements frequently made[3] as regards the use of this tree for resin are erroneous and can only be explained by a confusion of names, and it is most likely that the Cuban pine (*P. caribæa*) was referred to.[4] (H. J. E.)

## PINUS CANARIENSIS, Canary Pine

*Pinus canariensis*, Ch. Smith, in Buch, *Phys. Beschr. Canar. Ins.* 159 (1825); De Candolle, *Pl. Rar. Jard. Genève*, i. tt. 1, 2 (1829); Loudon, *Arb. et Frut. Brit.* iv. 2261 (1838); Webb et Berthelot, *Phyt. Canar.* iii. 280, Atlas, t. 6 (1845-50); Christ, in Engler, *Bot. Jahrb.* vi. 486 (1885); Masters, in *Gard. Chron.* iii. 723, f. 94 (1888), and in *Journ. Linn. Soc.* (*Bot.*) xxxv. 593 (1904); Clinton-Baker, *Illust. Conif.* i. 13 (1909).

A tree, attaining 80 ft. in height and 10 ft. or more in girth. Bark thick, reddish, slightly fissured, and separating on the surface into irregular scales. Young branchlets glabrous, yellow, with prominent keeled pulvini. Buds ovoid, acute, $\frac{3}{4}$ in. long, $\frac{1}{2}$ in. broad; scales reddish brown, matted together at the base by their marginal white fimbriæ, spreading, with their tips free and reflexed. The apices of the branchlets of the second and third years are each marked with a conspicuous sheath of the persistent reflexed bud-scales.

Leaves in threes, persistent two years, densely crowded on the branchlets, spreading, 7 to 12 in. (averaging 9 in.) long, $\frac{1}{20}$ in. wide, flexible, serrulate, ending in a fine cartilaginous point, with two to four stomatic lines on each of the three sides; marginal canals median; basal sheath $\frac{3}{4}$ in. long.

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[1] The tree at Tortworth Court, mentioned as *P. Tæda* by Kent in Veitch's *Manual*, p. 383, is *P. rigida.*

[2] Figured by Clinton-Baker, *Illust. Conif.* i. 54 (1909).

[3] As in Bastin and Trimble, *North American Coniferæ*, 44 (1897).

[4] Cf. Mohr, *op. cit.* 121.

Cones subterminal, solitary or clustered, deflexed or pendent, on short stout scaly stalks, cylindric-conic, with a flattened apex, very variable in length, averaging 5 in. long; shining yellowish brown, and closely resembling those of *P. Pinaster* in appearance; scales thick, about 1¾ in. long, and ¾ inch wide; apophysis rhomboid, slightly elevated, with a transverse sharp ridge, and a dark brown prominent non-prickly umbo. Seed ½ in. long, pointed at both ends, with a pale brown wing 1¼ in. long.

The seedlings have six to eight cotyledons, and grow rapidly, attaining 10 in. in their first year. In *Gard. Chron.* xv. 333 (1881), it is stated that Hochstetter had succeeded in fixing the juvenile form of this species and of *P. Pinea* by cuttings, producing beautiful bushes with solitary needles.

This species is endemic in the Canary Islands. It does not occur on some of the dry eastern islands, as Lanzarote and Fuerteventura; and only a single tree exists on Gomera, and a small wood on Ferro. According to Christ, it is called *tea* by the Spaniards, and was formerly widely spread, and descended lower on the mountains, than at present. Large woods still exist in Teneriffe, Palma, and Grand Canary, beginning at 3700 ft. altitude and ascending to where the snow lies in winter, solitary trees being met with on Teneriffe as high as 6600 ft. It grows on dry slopes, exposed to the sun and wind, and appears to prefer basalt, where the soil contains no lime. Its upper elevation is limited not so much by the cold, as by the poverty of the soil, which at high elevations consists of pumice stone, on which no tree growth can exist. Christ saw many beautiful woods, with an undergrowth of Cistus, and numerous seedlings growing under the shade of the parent trees. Many of the trunks[1] show the same character as *P. rigida*, as they produce epicormic branches covered with solitary primary leaves.

The trees are conical in shape, often branched to the ground, and somewhat weeping in habit, with pendulous leaves. Most of the famous trees of this species, one of which was mentioned by Loudon as 30 ft. in girth near the ground, were destroyed even in Webb's time; and the largest tree seen by Christ, the *Pino del Paso*, in Teneriffe, is only 10 ft. in girth; but he mentions old trees on Palma twice as thick.

The timber is reported to be remarkably heavy and durable. In the museum at Kew, there is preserved part of the beam of a wine-press, made of the heart-wood, which is quite sound, although the press was over 200 years old and had stood all the time in the open air.

This species is rare in cultivation in England, except as a green-house plant. Loudon states that specimens in the open were killed at Dublin. There is, however, a small tree, at Heligan, Cornwall, which in 1906 was fifteen years old and about 25 ft. high; and another at Carclew about 6 ft. high, which was slightly damaged by frost in 1908-1909.

It succeeds well on the Riviera, even on calcareous soil; and there are fine specimens at La Mortola and Grimaldi.[2] Elwes measured one at the Villa Thurêt, Antibes, 92 ft. by 5½ ft., which bore fertile cones in January 1910. (A. H.)

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[1] Cooley, in *Bot. Gazette*, xxxviii. 441, fig. 1 (1904), describes a tree in the Botanic Garden at Naples, the stem of which is clothed to the ground with shoots like those of *P. rigida*.

[2] Cf. *Gard. Chron.* iv. 39 (1888).

## PINUS ECHINATA, Short-leaf Pine

*Pinus echinata*, Miller, *Dict.* Ed. 8, No. 12 (1768); Sargent, *Silva N. Amer.* xi. 143, t. 587 (1897), and *Trees N. Amer.* 29 (1905); Mohr, *U.S. Forestry Bulletin* No. 13, *Timber Pines of Southern U.S.* 91, plates 13-16 (1897); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 624 (1904).

*Pinus virginiana*, Miller, var. *echinata*, Du Roi, *Obs. Bot.* 44 (1771).

*Pinus squarrosa*, Walter, *Fl. Carol.* 237 (1788).

*Pinus Tæda*, Linnæus, var. *variabilis*, Aiton, *Hort. Kew.* iii. 368 (1789).

*Pinus Tæda*, Linnæus, var. *echinata*, Castiglioni, *Viag. negli Stati Uniti*, ii. 312 (1790).

*Pinus mitis*, Michaux, *Fl. Bor. Amer.* ii. 204 (1803); Loudon, *Arb. et Frut. Brit.* iv. 2195 (1838); Kent, Veitch's *Man. Coniferæ*, 342 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 358 (1906); Clinton-Baker, *Illust. Conif.* i. 32 (1909).

*Pinus variabilis*, Lambert, *Genus Pinus*, i. 22, t. 15 (1803).

A tree, attaining in America 120 ft. in height and 12 ft. in girth. Bark about an inch thick, broken into large irregular scaly plates. Young branchlets slender, brittle, glabrous, glaucous; in the third year the bark of the branchlets exfoliates in large flakes. Buds, ¼ in. long, cylindrical, sharp-pointed, brownish, shining, with resinous and appressed scales.

Leaves, both in pairs and in threes, deciduous in the second and third years, spreading, about 3 in. long, slender, flexible, curved, slightly twisted, serrulate, sharp-pointed, with stomatic lines on all three surfaces; resin-canals median; basal sheath ⅜ in. long.

Cones lateral, either subsessile and spreading, or short-stalked and pendulous, in pairs or clusters of three or four, ovoid, 1½ to 2 in. long, dull brown; scales about ¾ in. long, obovate, cuneate, rounded at the apex, thin and flexible; apophysis slightly thickened, with a transverse ridge and a central umbo, armed with a short, often deciduous, prickle. Seed triangular, brownish-black, 3/16 in. long; wing ½ in. long, pale, streaked with brown lines; cotyledons 4 to 7.

This species is readily distinguishable by the leaves, both two and three in a cluster, and by the peculiar scaling of the bark on the branchlets in the third year.

A complete account of this pine, with a map of its distribution, is given by Mohr, who states that it is a tree of the plains and foothills, in the south rarely ascending to 2500 ft., and in the north never higher than 1000 ft. East of the Mississippi it is now found scattered amongst the broad-leaved trees; but in the beginning of the nineteenth century it formed a considerable part of the coniferous forest, growing on light sandy soil in the Atlantic states from New York to Virginia.

(A. H.)

This tree has much the same distribution as *P. Tæda*, occurring from Staten Island, New York, and east Pennsylvania, through the Atlantic states to northern Florida, crossing the Alleghany Mountains to Kentucky and Tennessee, and extending west to north-eastern Texas, north-western Louisiana, Arkansas, southern Missouri and south-west Illinois. It is more abundant inland than on the coast region of the Gulf states, where the pitch pine replaces it; and is most abundant and in the greatest perfection west of the Mississippi river, where it forms large forests and is the most important source of the timber known in the United States as yellow pine, which is used more largely for ordinary building purposes in the south-western states than any other wood; and as this tree has the power of spreading itself rapidly over abandoned fields, which it soon covers with healthy forest, it is not likely to become scarce. According to Mohr, average trees in Arkansas and Texas range from 95 to 120 ft. high, and 17 to 25 in. in diameter, at ages of 100 to 200 years.

According to Sargent this timber[1] is very variable in quality, but only second to true pitch pine in its class, and being less resinous, softer and more easily worked, is often preferred for cabinet-making, interior finish, doors, window-sashes, etc. It is also largely used for flooring, weather-boarding, railway cars and sleepers.

Though it does not yet seem to be well known in Europe, yet as pitch pine becomes scarcer and dearer, it will no doubt be substituted for it, or for white pine (*P. Strobus*), which is already known in the English market as yellow pine.

This pine is remarkable for its capacity of producing vigorous sprouts[2] from the stumps, when the tree is felled or injured by fire. These coppice shoots, ten to thirty in number from each stump, remain bushy, attaining no great height, and are of no value for the regeneration of the tree.

*P. echinata* was introduced into England about 1739, as Miller had it in cultivation in that year; but has proved as unsuitable for this climate as most of the other pines of the Atlantic coast, and is probably short-lived, as it is very rare in collections.[3] A tree at Dropmore, which in 1908 measured 50 ft. high and 3 ft. 4 in. in girth, is probably the specimen mentioned by Loudon as being cultivated there under the name *P. variabilis*, which it still bears. Mr. Page says that it occasionally bears a few cones, but that he has not succeeded in raising plants from the seed. Another specimen at Bayfordbury is 34 ft. by 3 ft.; and one in Kew Gardens, which bore a few cones in 1908, measured 32 ft. by 2 ft. 4 in. in 1909.

(H. J. E.)

## PINUS HALEPENSIS, ALEPPO PINE

*Pinus halepensis*, Miller, *Dict.* Ed. 8, No. 8 (1768); Loudon, *Arb. et. Frut. Brit.* iv. 2231 (1838); Boissier, *Flora Orientalis*, v. 695 (1884); Masters, *Gard. Chron.* xxii. 552, f. 97 (1884), iii. 627, f. 84 (1888), and *Journ. Linn. Soc.* (*Bot.*) xxxv. 606 (1904); Willkomm, *Forstliche Flora*, 237 (1887); Mathieu, *Flore Forestière*, 607 (1897); Kent, Veitch's *Man. Coniferæ*, 332 (1900); Clinton-Baker, *Illust. Conif.* i. 23 (1909).
*Pinus alepensis*, Poiret, in Lamarck, *Dict.* v. 338 (1804).
*Pinus hierosolymitana*,[4] Duhamel, *Traité des Arbres*, ii. 126 (1755).
*Pinus maritima*, Lambert, *Gen. Pinus*, i. t. 6 (1832) (not Miller).

A tree attaining 80 ft. in height and 12 to 15 ft. in girth, though often, on poor soils, considerably smaller. Bark at first smooth, silvery grey, and shining, becoming on old trunks reddish brown, fissured, and scaly. Young branchlets glabrous, glaucous grey, flexible, with slightly raised pulvini. Buds conical, slender, less than ½ in. long, brownish white; scales interlaced by white fimbriated margins, with the tips free and often reflexed. Base of the shoot girt with a sheath of reflexed bud-scales.

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[1] The wood of this pine is indistinguishable from that of *P. Tæda*. Cf. Fernow and Roth, in *U.S. Forestry Bulletin* No. 13, pp. 13, 14 (1897).

[2] Cf. *Garden and Forest*, x. 192, 209 (1907), and Roth, in *U.S. Forestry Bulletin* No. 13, p. 111 (1897), who observed hundreds of acres along the railways in Texas and Arkansas, covered with bushy clusters of vigorous sprouts from the pine stumps. In *Bot. Gas.* xxviii. 69 (1899), *P. echinata* is said to produce root-suckers, but this seems to be erroneous.

[3] A tree at Bicton, of which we have specimens with stunted foliage, doubtfully referable to this species, died recently.

[4] This name is uncertain, and cannot be adopted; moreover, it would be inconvenient to set aside *halepensis*, which has been in use for over a century. Cf. Graebner, in *Mitt. deut. dend. Ges.*, 1908, p. 68.

Leaves in pairs, persisting two years, 2½ to 4 in. long, slightly spreading, slender (about $\frac{1}{32}$ in. wide), curved, twisted in the upper third, serrulate, short-pointed, with stomatic lines on both surfaces; resin-canals marginal; basal sheath ⅓ in. long, persistent.

Cones, solitary or two or three together, lateral, spreading or deflexed, on thick scaly stalks (about ½ in. long), ovoid-conic, 2 to 3 in. long; scales shining, yellowish brown, oblong, flat, about an inch long and ⅝ in. wide; apophysis rhomboidal, flat, or slightly raised towards the centre, with a transverse linear ridge; umbo greyish, depressed, often with a slight ridge, unarmed. Seed, nearly ¼ in. long, light brown on the lower and blackish on the upper surface; wing pale brown with a dark border, nearly an inch in length. The cones are variable in direction, though often directed backwards, and are irregular in the time of opening, some remaining closed till May in the third year, others not letting out the seeds till the fifth or sixth year.

## Variety

### Var. *Brutia.*

*Pinus Brutia*, Tenore, *Flora Napolitana*, i. Prod. p. lxxii (1811), iv. 136 (1830), and v. 266, f. 200 (1835); Loudon, *Arb. et Frut. Brit.* iv. 2234 (1838); Boissier, *Flora Orientalis*, v. 695 (1884); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 608 (1904).
*Pinus resinosa*, Loiseleur, in *Nouveau Duhamel*, v. 237 (1812) (not Solander).
*Pinus Pithyusa*,[1] Steven, *Bull. Soc. Nat. Mosc.* i. 49 (1838).
*Pinus persica*, Strangways, in Loudon, *Gard. Mag.* xv. 130 (1839).
*Pinus Loiseleuriana*, Carrière, *Conif.* 382 (1855).
*Pinus Paroliniana*, Webb, *ex* Carrière, *Conif.* 391 (1855).
*Pinus pyrenaica*,[2] Carrière, *Conif.* 391 (1855); Masters, in *Gard. Chron.* iv. 267, f. 32 (1888); Kent, Veitch's *Man. Coniferæ*, 368 (1900); Mayr,[3] *Fremdländ. Wald- u. Parkbäume*, 360 (1906).
*Pinus Parolinii*, Visiani, *Mem. Ist. Venet.* vi. 243 (1856).
*Pinus Eldarica*, Medwejew, in *Act. Hort. Tiflis*, vi. 2, p. 21 (1902), and *Bäume u. Sträuche Kaukasus*, i. 20 (1907); Masters, in *Gard. Chron.* xxxiv. 251 (1903).

This is a geographical variety of *P. halepensis*, distinguished by its longer, darker green, and more rigid leaves, 4 to 6 in. in length. The cones,[4] which occasionally arise in whorls of three to six, are never deflexed, but always spreading or pointing forwards, and are in rare cases sub-sessile. The staminate flowers are also larger than in the type. The differences observable, due to the influence of soil and climate, are similar to those seen in the Austrian and Corsican varieties of *P. Laricio.*

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[1] Referred to *P. Brutia* by Lipsky, in *Act. Hort. Petrop.* xiv. 309 (1898). According to Loudon, *Gard. Mag.* xv. 130 (1839), the cone is like that of *P. halepensis* in the strong woody peduncle.

[2] Probably not *P. pyrenaica*, Lapeyrouse, *Hist. Abrégée Pl. Pyrén.* Suppl. 146 (1818), occurring in the Pyrenees, and identified by Calas with the Pyrenean variety of *P. Laricio*. Cf. our vol. ii. 407, note 2. The large forests of *P. pyrenaica* in Spain, described by Captain Cook, are *P. Laricio*. Cf. Willkomm, *Pflanzenverb. iberischen Halbinsel*, 109 (1896).

[3] Mayr places *P. halepensis* and var. *Brutia* in different sections, though the character on which he relies for this distinction, the position of the cones, is identical in both.

[4] All the specimens of *P. Brutia* in Parlatore's herbarium at Florence are from cultivated trees, and differ only from *P. halepensis* in their longer leaves and larger cones. So far as I could judge from these, and from a Calabrian specimen, the differences between this variety and typical *P. halepensis* simply depend on the greater vigour of the former, due to better soil and climate.

## DISTRIBUTION

The Aleppo pine is a Mediterranean species, occurring in almost all the countries bordering on its shores, from Spain to Asia Minor, and from France and Dalmatia to Morocco and Algeria.

In France this species occurs in Provence, in the region of the olive, from the foot of the Alps westward to Sommières, Gard, never extending far from the sea-coast, and not extending above 2700 ft. altitude. It grows mainly on limestone, occupying dry rocky slopes, where scarcely any other tree will grow, but is also common on the porphyry of the Estérel, and is met with on gneiss near Cannes.[1] On Mount Ventoux it ascends to 1300 ft., but at this elevation and distance from the sea is liable to suffer from frost. Large forests occur, as that of Mérindol on Mount Luberon, which covers 4000 acres, and is composed of a mixture of Aleppo pine and *Quercus Ilex.*

Here the trees are usually small in size and stunted in growth, with crooked stems, as the soil is arid and shallow limestone; but in a ravine, where there was some moisture and a growth of ferns, I measured a tree 80 ft. in height, with a straight stem, free of branches to 50 ft., and 8 ft. in girth. In Spain[2] this species is a native of all the provinces bordering on the Mediterranean, and extends inland as far as Huesca, Saragossa, Teruel, Cuenca, and Guadalajara, growing in the lower regions of the mountains up to 3300 ft., and somewhat rare on the coast itself, though there is a remarkable wood, covering the greater part of the Dehesa de Valencia, a sandy spit of land, about 8 miles long, separated from the sea by the Albufera lagoon. There are small woods on limestone east of Gaucin, north of Gibraltar, where I measured a tree at 900 ft. elevation, 65 ft. in height, and 10 ft. 8 in. in girth.

It is common in the Balearic Isles, where it ascends in Majorca as a tree to 3200 ft., becoming a mere bush at 3900 ft. On Iviza there is a forest 16,000 acres in extent, consisting of *P. halepensis*, partly pure and partly mixed with deciduous trees.

In Italy it is not found north of the Apennines, but it is fairly common on the west and east coasts. It grows,[3] though in much less abundance than in the Riviera, on serpentine rocks between Savona and Genoa, and occurs in the mountains of Umbria between Spoleto and Terni, ascending on Somma to about 2000 ft. About the falls of the Velino, and in the defile through which the Nar flows below Narni, it is pretty frequent, growing on limestone amidst the woods of *Quercus Ilex.* On the eastern side of the Adriatic[4] it succeeds as a planted tree in Dalmatia, but is only wild south of latitude 43°, occurring in small quantity about Ragusa and in the Meleda and Curzola islands. It has also been observed by Baldacci in Albania.

It is common in Greece, except in southern Peloponnesus, and also occurs in Crete and most of the islands, often forming extensive forests near the sea-coast, and occasionally ascending to 3000 ft. Prof. Samios of Athens informs us that a tree at Chalcis, which Elwes saw many years ago, is 130 ft. in height, and 10½ ft. in girth. In Cyprus[1] this is a finer tree than *P. Laricio*, often attaining in the forest 10 ft. in girth, but on dry ground on the hot coast it assumes a bushy form. Mr. A. K. Bovill, Principal Forest Officer in Cyprus, informs us that he has photographed a tree 15 ft. in girth. According to Madon,[2] it flourishes on all soils up to 5000 ft., mixing above 4500 ft. with *P. Laricio*.

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[1] Bunbury, *Bot. Fragments*, 8 (1883).

[2] Willkomm, *Pflanzenverb. iberischen Halbinsel*, 95, 190 (1896).

[3] Cf. Bunbury, *Bot. Fragments*, 8 (1883). Sprenger, in *Mitt. deut. dendr. Ges.*, 1905, p. 182, says there are fine trees on the heights of Posilippo, near Naples, and notes the great quantity of its cones, even when the trees are very young. The pollen is so abundant that people who suffer from hay fever avoid it.

[4] Cf. Beck, *Veget. illyrischen Länder*, 135 (1901).

This species also occurs in west and south Asia Minor, covering the sand dunes of the Cilician coast westwards from Mersina; and on the coast of Syria and the lower ranges of the Lebanon is a handsome tree, judging from a photograph (Plate 287) sent us by Dr. Day of Beyrout.

In Algeria *P. halepensis*, pure or mixed with *Quercus Ilex*, forms the greater part of the forests, where the rainfall is less than 12 in. annually, and extends from the sea-coast to about 5000 ft. altitude. It grows mainly on limestone, but is occasionally seen on clay, sandstone, and conglomerate. It is remarkable for its reproductive power, as seedlings are very numerous, and regeneration is certain to ensue after the destruction of the forests by axe or fire. In the dry regions of Algeria, where forest fires are common, it is apparently adapted for natural regeneration on burnt areas, as cones with fertile seed are always present on the trees. Young trees bear cones when only 5 or 6 ft. high, while older trees retain many of the cones closed for six or eight years; and these, when scorched by fire, burst and scatter the seed to a distance of 10 or 20 yards.[3] This is well seen in a forest near Affreville, where *P. halepensis* is the predominant species, mixed with a small proportion of *Callitris quadrivalvis* and *Quercus coccifera*. Here the trees are of no great size, but I measured one in the open 70 ft. high and 14 ft. 11 in. in girth.

In Morocco it apparently does not occur near the coast, but is reported by Ball[4] to grow in the mountains to the south at 4000 to 5500 ft. altitude. It is met with in Egypt, near Alexandria, but is probably planted there.[5]

Var. *Brutia* has a more restricted and a more easterly distribution than the type. It is met with in Calabria in Italy, where it was discovered by Tenore in the Aspromonte mountains between 2400 and 3600 ft. altitude. According to Sprenger,[6] it grows here on limestone, ascending to 5000 ft., and attaining about 80 ft. in height and 250 years in age. He says that the wood is white and free from resin. According to Halacsy,[7] it is absent from the mainland of Greece, but occurs at high elevations in Crete. It grows on the shores of the Sea of Marmora, where it is known as *kara jcham* or black pine.[8] It seems to be the mountain form in Asia Minor, occurring in Pamphylia, Cilicia, and on the Taurus and Lebanon, the tree near the coast being typical *P. halepensis*. Specimens collected in 1874 by Elwes in Lycia, and noted as growing on limestone, are var. *Brutia.* This variety[1] also grows sparingly on the north-east coast of the Black Sea near Pizunda,[2] and a small forest, about 4 miles in length, of trees not exceeding 40 ft. in height, occurs in the centre of Transcaucasia, at the foot of the great Caucasus, on the west edge of the Eldar Steppe, between 1400 and 2000 ft. elevation.[3]

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[1] Cf. Hartmann, in *Mitt. deut. dend. Ges.*, 1905, p. 169.

[2] *Forests of Cyprus*, in *Cyprus, Parliament. Paper* No. 366, of 1881.

[3] Cf. Lefebvre, *Les Forêts de l'Algérie*, 421 *seq.* (1900). The part which the persistent closed cones play in the regeneration has not been understood by local observers, who assert that the cones on very young trees produce unfertile seed. This requires further investigation.

[4] In *Journ. Linn. Soc.* (*Bot.*) xvi. 669 (1878).

[5] Boissier, *Flora Orientalis*, v. 695 (1884).

[6] In *Mitt. deut. dend. Ges.*, 1904, p. 191.

[7] *Consp. Fl. Graecae*, iii. 453 (1904).

[8] Specimens procured for Mr. H. Clinton-Baker by Mr. Stuart Hogg.

This variety is cultivated in Afghanistan, where it was collected by Aitchison, and in Persia where, Dr. Stapf informs us, it is a tall tree, resembling *P. sylvestris* in habit, and very hardy, as it bears without injury severe winters and a heavy snowfall. Two plants raised at Vienna from seed brought home by Dr. Stapf from Shiraz were at first indistinguishable from seedlings of typical *P. halepensis,* but as they grew older bore the longer foliage of var. *Brutia.* (A. H.)

### CULTIVATION

Though this tree was introduced by Bishop Compton in 1683, and has been often planted since, it is not hardy enough to endure severe winters;[4] and the trees mentioned by Loudon[5] at White Knights, Berks, and Croome, Worcester, which in 1838 were 57 and 40 ft. high, are no longer living. The only trees[6] of considerable size which we have seen are one at Margam, Glamorganshire (Plate 288), which in 1907, when I saw it, was a healthy tree, measuring 72 ft. by 10 ft., and bearing many cones, which are conspicuous from their green colour, and another in the Botanic Garden, Bath, which was 46 ft. by 4 ft. 6 in. in 1909, and is a healthy tree with smoother and greyer bark than *P. Pinaster.* There are small trees at Kew and Bicton.

Seedlings which I raised from Spanish seed in 1907 were, with three exceptions, killed by the frost of January 1909, though protected by boughs laid over them, and it seems useless to attempt to grow this tree except in very dry, warm, and sheltered situations near the sea in the south of England.

According to Loudon,[7] var. *Brutia* was introduced in 1836, when it was raised from seed by the Earl of Mountnorris. Strangways, in 1839, obtained seeds from Persia, plants from which were raised in the garden of the Horticultural Society, and were known as *P. persica.* No trees of this variety are now in cultivation in this country, so far as we know, except a small specimen at Kew.

In February 1910 I saw the tree in the Botanic Garden at Naples, on which Tenore founded his description of *P. Brutia.* It is very vigorous, with a wide-spreading crown of foliage, and measured 82 ft. by 10 ft. A branch sent to Cambridge by the director, M. Cavara, bears seven young cones in a whorl, and two mature cones in a second whorl, which scarcely differ from those of *P. halepensis.*

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[1] Lipsky, in *Act. Hort. Petrop.* xiv. 309 (1898), denies the occurrence of *P. halepensis* in Russian territory bordering on the Black Sea, all the specimens being *P. Brutia.*

[2] Radde, *Pflanzenverbreit. Kaukasus,* 147 (1899).

[3] This is supposed to be a distinct species, *P. eldarica* of Medwejew, who refers the tree on the Black Sea to *P. pithyusa,* Strangways. Cf. *Derevya Kavkasa,* 12, 14 (1905), and *Moniteur Jardin Bot. Tiflis,* ii. 26 (1906).

[4] Mouillefert, *Essences Forestières,* 386 (1903), says that it is killed by 14 or 15 degrees of frost, and that it grows rapidly in youth, and is very intolerant of shade.

[5] Lambert says that he saw a flourishing tree of this species bearing cones abundantly at 17 years after planting in the garden of Stoke Park, Wilts, on sandy soil; but Lady Lushington informs me that when she first lived, in 1881, at this place, now called Stokke, there was no such tree there.

[6] The tree at Penrhyn, a cone of which was figured in *Gard. Chron.* xxii. 552, fig. 97 (1884), no longer exists. Webster in *Woods and Forests,* 19th November 1884, says it was 45 ft. high and 4 ft. in girth.

[7] *Trees and Shrubs,* 968 (1842), and *Gard. Mag.,* 1839, p. 267.

The leaves are longer than is usually the case in var. *Brutia*, measuring about 7 in. in length, which is probably due to the rich volcanic soil in which the tree is growing. Henry sees no reason for supposing that the tree is a hybrid, though from its vigour M. Cavara thinks that it differs from the wild trees in Calabria, which are ascribed to var. *Brutia*.

There is a fine tree, under the name *P. pyrenaica*, in the grounds of the Villa Thurêt, Antibes, which was 70 ft. by 6 ft. 2 in. when I saw it in 1910, and bore cones larger than those of typical *P. halepensis*.

The timber[1] is considered in France inferior to that of *P. Pinaster*, and is characterised by large resin-canals, which often cause infiltrations of resin in the wood, rendering it hard, heavy, and difficult to saw. It is little used, except for making packing-cases, though sometimes it is suitable for telegraph poles and sleepers. Tapping for resin, formerly practised in Provence, is now little in vogue; but in 1906, an experiment was made in the forest of Slisser, in western Algeria, when about a million trees were tapped. The resin produces a turpentine of good quality. The bark contains a considerable amount of tannin, and in Provence is occasionally ground into powder, which is used for dyeing fishing nets, and for mixing with the tanning material obtained from the bark of *Quercus coccifera*.

(H. J. E.)

## PINUS MURICATA, Bishop's Pine

*Pinus muricata*, Don, in *Trans. Linn. Soc.* xvii. 441 (1836); Lambert, *Genus Pinus*, iii. t. 84 (1837); Loudon, *Arb. et Frut. Brit.* iv. 2269 (1838); Masters, in *Gard. Chron.* xxi. 49, tt. 7-9 (1884), and *Journ. Linn. Soc.* (*Bot.*) xxxv. 620 (1904); Sargent, *Silva N. Amer.* xi. 139, tt. 585, 586 (1897), and *Trees N. Amer.* 32 (1905); Kent, Veitch's *Man. Conif.* 350 (1900); Clinton-Baker, *Illust. Conif.* i. 37 (1909); Bean, in *Gard. Chron.* xlv. 260, figs. 112, 113 (1909).

*Pinus Edgariana*, Hartweg, in *Journ. Hort. Soc.* iii. 217, 226 (1848).

A tree, usually 40 to 50, occasionally 90 ft. high, and 6 to 10 ft. in girth. Bark reddish brown, fissuring into long narrow rounded scaly ridges, becoming very thick,[2] 4 to 6 in., towards the base of old trunks. Young branchlets glabrous, stout, reddish brown, with projecting pulvini, separated by linear grooves. Buds conic or cylindrical, pointed, ¾ to 1 in. long, encrusted with white resin. Scale-leaves persistent at the base of the leaf-clusters.

Leaves[3] in pairs, persistent for three or four years, spreading, crowded on the branchlets, 4 to 6 in. long, yellowish green, rigid, slightly curved and twisted, serrulate, marked with numerous stomatic lines on both surfaces, ending in a short callous tip; resin-canals median; basal sheath ½ in. long.

Cones, both sub-terminal and lateral, in clusters of 3 to 7, deflexed, sessile, asymmetrical, oblique at the base, ovoid, about 3 in. long, shining brown, very prickly: scales transversely keeled; on the inner side of the cone with flattened apophyses and slender prickles; on the outer side of the cone with elevated pyramidal apophyses, armed with stout sharp spines, in the basal scales directed downwards, in the apical scales recurved and pointing upwards. Seed triangular, ¼ in. long, roughened, grooved, and blackish ; wing nearly 1 in. long.

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[1] Mr. Hutchins, however, informs me that in Cyprus it is of better quality, and is used for all purposes for which deal is used here.

[2] In *Garden and Forest*, x. 232, fig. 30 (1897), a figure of the tree is given, showing the remarkable thickness of the bark.

[3] The leaves have a strong peculiar odour.

The cones often remain closed for many years, persisting on the stem and branches of the tree, without becoming embedded in the bark. As in the case of other pines, with late-opening cones, this is a provision for the germination of the seeds, which retain their vitality for a long period, until forest fires cause the scales to gape asunder.

This species, in the absence of cones, is readily distinguished amongst the two-leaved pines with persistent sheaths, by its long yellowish green leaves, and its long buds whitened in a peculiar manner by resin. On a vigorous branch two whorls of buds, branchlets, and cones are usually produced.

This species is one of the four coast trees[1] of California, only growing near the sea within the range of the sea-fogs, and occasionally rising to 2000 ft. altitude. It occurs in Mendocino County, where it attains its largest size, southwards, usually in widely separated localities, to Tornales Point, north of San Francisco Bay ; and from Monterey to San Luis Obispo County. It is also met with in Lower California, on Cedros island, and on the coast between Ensenado and San Quintin.

This pine, like *P. contorta*, which replaces it northward, grows on ocean bluffs, and sometimes is common over considerable tracts of poor sandy soil. In Sonoma County,[2] it reaches its most vigorous development in peat-bogs, the trees attaining a height of 80 to 150 ft. It is remarkable in its native habitat for its flattened crown of foliage. Jepson mentions a very fine forest of this species on Point Reyes, within a few miles of Olema. (A. H.)

*P. muricata* was first discovered in 1832 by Dr. Coulter at San Luis Obispo, and is sometimes known as Bishop's pine, from its occurrence in this locality, named after Bishop St. Louis. It was introduced into England in 1846 by Hartweg, who found it near Monterey, and who named it *P. Edgariana*, after Mr. T. Edgar, Secretary of the Horticultural Society.

It is perfectly hardy in most parts of England, and though seldom planted is perhaps suitable as a shelter tree on the sea-coast, though it is much surpassed in growth in such situations by *P. radiata*. Mr. Bean says that it thrives very well in Scilly and in the Channel Isles in very exposed situations.

Probably the finest specimen of this species in England is a tree, growing at Claremont, which has a tall straight stem, and measured in 1907, 71 ft. high by 7 ft. in girth. In Kew Gardens there is a tree of no great height, but of considerable age, remarkable for the old cones, which are borne unopened on the stem ; and another,[3] near the Pagoda, prostrate and bushy in habit, is very peculiar in its appearance. In the wilderness at White Knights, a fine healthy tree, 57 ft. by 7 ft., was measured by Henry in 1904. At Pitt House, Chudleigh, there is a large spreading tree, about 50 ft. high, with many stems, and covered with old persistent cones, of which I counted about sixty whorls, the oldest of which were nearly buried in the bark. At Eastnor Castle, a tree was about 40 ft. by 6 ft. in 1907, with large bunches of cones, no less than thirty-seven of which were counted in one cluster.

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[1] The others are *Pinus radiata*, *P. contorta*, and *Cupressus macrocarpa*.

[2] Jepson in *Flora W. Mid. California*, 23 (1901). Engelmann, in Brewer and Watson, *Botany of California*, ii. 128 (1880), says it is also found of large size growing in peat-bogs in Mendocino County.

[3] Figured in *Gard. Chron.* xlv. 260, fig. 111 (1909). Mr. Bean attributes its prostrate habit to the attacks of a boring beetle in early life, which killed many buds and prevented the formation of leading shoots.

At The Heath, Leighton Buzzard, a large but ill-shaped tree measured 55 ft. by 7 ft. 2 in. in 1908. At Flitwick Manor, Bedford, Mr. H. Clinton-Baker measured in 1908, a tree 64 ft. by 8 ft. 8 in. At Essendon Place, Herts, there is a fine wide-spreading tree,[1] 49 ft. by 7 ft. 3 in. in 1906. At Garston Manor, Watford, Sir Hugh Beevor found one which measured 64 ft. by 6 ft. 3 in. in 1909. At Brickendon Grange, in the same county, there is a tree, about 25 ft. high, from the seed of which, obtained by heating in an oven an old cone from a main branch, Mr. J. Trotter raised seedlings in 1907. At Bayfordbury, a tree planted in 1850 measures 45 ft. by 4 ft. 7 in.; and numerous seedlings were raised in 1906 from the seed in its old cones.

A healthy wide-spreading tree at Enville Hall, Stourbridge, measured 56 ft. by 8 ft. 9 in. in 1904. At Highnam, Gloucestershire, there is a tree with a divided stem about 60 ft. high. At Hafodunos, North Wales, a wide-spreading tree, densely clothed to the ground, was 56 ft. by 7 ft. 3 in. in 1905.

In Scotland, Sir Herbert Maxwell reports a tree of this species at Stonefield, Argyllshire; and Mr. Austin Mackenzie measured a tree at Carradale, in the same county, 43 ft. by 4 ft. 9. in. in 1906. At Castle Kennedy, a spreading tree, bearing numerous cones, was 35 ft. by 5 ft. 7 in. in 1904.

In Ireland,[2] the finest specimens, five in number, are growing in Lauragh churchyard, near Derreen, one of which in 1907 measured 66 ft. by 6 ft. There is also a tree about 50 ft. high in the grounds of Derreen. At Coolattin, Co. Wicklow, a tree, very vigorous in growth and coning freely, was 42 ft. by 4 ft. 8 in. in 1906. At Castlemacgarrett, Co. Mayo, another measured 49 ft. by 5 ft. 9 in. in 1904.

(H. J. E.)

## PINUS PUNGENS

*Pinus pungens*, Lambert, in Konig and Sims, *Ann. Botany*, ii. 198 (1806); Michaux f., *Hist. Arb. Amer.* i. 61, t. 5 (1810); Loudon, *Arb. et Frut. Brit.* iv. 2197 (1838); Sargent, *Silva N. Amer.* xi. 135, t. 584 (1897), and *Trees N. Amer.* 33 (1905); Kent, Veitch's *Man. Coniferæ*, 367 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 623 (1904); Clinton-Baker, *Illust. Conif.* i. 47 (1909).

A tree, attaining 60 ft. in height and 9 ft. in girth; but usually smaller with a short thick trunk, frequently clothed to the ground, and forming a flat-topped or rounded head of foliage. Bark 1 in. thick, broken into irregular reddish brown scaly plates. Young branchlets glabrous, shining brown, with projecting pulvini, separated by linear grooves. Buds cylindrical, pointed, about ¾ in. long, resinous.

Leaves in pairs, deciduous in the second and third years, crowded on the branchlets, spreading, dark green, stout, rigid, curved, twisted, 2 to 2½ in. long, serrulate, ending in a sharp cartilaginous point, marked with numerous stomatic lines on both surfaces; resin-canals median; basal sheath ¼ in. long.

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[1] According to an account of the pinetum at Essendon in *Gard. Chron.*, 1866, p. 950, this tree was, in 1866, 35 ft. high, and bore cones twenty years old on the branches.

[2] In *Gard. Chron.*, 1869, p. 193, a tree, 20 ft. high, was reported as growing at Somerville, near Navan, Co. Meath, which had branches with seven to nine whorls of cones.

Cones lateral, usually in clusters of three or four, rarely seven or eight; subsessile, spreading or deflexed, oblique at the base by the greater development of the scales on the upper side, light brown and shining, ovoid-conical, about 2½ in. long; scales thin and tough, about 1 in. long and ½ in. broad; apophysis pyramidate divided by a sharp transverse ridge into a narrow upper and a broad lower part, umbo produced into a long sharp-curved spine. Seed nearly triangular, ⅕ in. long, light brown; wing ¾ to 1 in. long; cotyledons 7 or 8.

This pine is readily distinguished from the other species with short leaves in pairs, by the stout sharp-pointed rigid leaves, and the shining reddish brown branchlets, which, when vigorous, develop buds, branchlets, or young cones about their middle point.

This species occurs in the Alleghany mountains, from Pennsylvania to North Carolina and eastern Tennessee, ascending to 3000 ft., and growing mainly on dry gravelly table-lands and slopes. To the northward it is local in its distribution, and generally scattered among other trees, as *Pinus echinata*, *P. rigida*, and *P. virginiana*, oaks and hickories; but in the southern Alleghanies it forms nearly pure forests of considerable extent. It is also found[1] in three isolated stations, distant from its mountain home: in Virginia, between Fredericksburg and Washington city; in Lancaster County, Pennsylvania; and near Rosemount, in New Jersey. It is hardy and thrives well when planted in the middle and eastern states, as far north as New England; but according to Sargent, has little to recommend it but its large abundant cones, which often, after opening, remain persistent on the branches for many years. The wood[2] is light, soft, brittle, and coarse-grained, and is little used except for fuel and charcoal.

This pine was introduced[3] into England in 1804, by Sir W. Strickland,[4] but has never become common. The only trees which we have found, besides one or two specimens of no great size in Kew Gardens, are two at Bayfordbury, planted in 1851, and now about 30 ft. high and a foot in diameter, which bear cones profusely; a tree at Bicton, 42 ft. by 3 ft. 7 in.; and another at Grayswood, Haslemere, 35 ft. by 2 ft. 7 in. There is also one about 30 ft. high at Menabilly. (A. H.)

## PINUS VIRGINIANA, Jersey Pine, Scrub Pine

*Pinus virginiana*, Miller, *Dict.* Ed. 8, No. 9 (1768); Sargent, *Silva N. America*, xi. 123, t. 581 (1897), and *Trees N. America*, 30 (1905); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 623 (1904).

*Pinus inops*, Solander, in Aiton, *Hort. Kew.* iii. 367 (1789); Loudon, *Arb. et Frut. Brit.* iv. 2192 (1838); Kent, Veitch's *Man. Coniferæ*, 333 (1900); Clinton-Baker, *Illust. Conif.* i. 25 (1909).

*Pinus Royleana*,[5] Jamieson, *ex* Lindley in *Journ. Hort. Soc.* ix. 52 *cum icone* (1855).

A tree, attaining 40 ft. in height, with a short trunk rarely more than 5 ft. in girth. Bark ¼ to ½ in. thick, broken by shallow fissures into scaly plates. Young branchlets slender, tough, flexible, glabrous, glaucous, violet in colour. Buds about ⅜ in. long, cylindrical, pointed, coated with resin.

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[1] Cf. T. C. Porter, in *Garden and Forest*, 1893, p. 204.

[2] Hough, *Trees U. States and Canada*, 19 (1907).

[3] Aiton, *Hort. Kew.* v. 314 (1813).

[4] The late Sir C. Strickland informed us that he remembered the tree at Boynton, 10 or 12 ft. high, and bearing prickly cones, which never produced good seed, and died many years ago.

[5] The specimen described under this name, was a tree 30 ft. high, cultivated in the Residency Garden at Kathmandoo, India. According to Gordon, quoted by Lindley, in *Gard. Chron.*, 1855, p. 612, this is *P. inops* (*P. virginiana*), with which the figure of the cone and leaves agrees. Seeds were sent to the Horticultural Society from India, and only a few germinated.

Leaves in pairs, deciduous[1] in the third and fourth year, slightly spreading, 1½ to 3 in. long, curved, slightly twisted, serrulate, sharp-pointed, marked by numerous stomatic lines on both surfaces; resin-canals median; basal sheath 3⁄16 in. long.

Cones lateral, spreading, solitary or in pairs, shortly stalked, ripening and opening the scales in the autumn of the second year, ovoid-conic, 2 to 2½ in. long, reddish brown, prickly; scales, ¾ in. long, ⅜ to ½ in. broad, thin, nearly flat, oblong-cuneate; apophysis rhomboidal, elevated, crenate in the upper margin, with a sharp transverse ridge, and a convex umbo, tipped by a slender spreading prickle. Seed nearly oval, pale brown, ¼ in. long; wing ⅓ in. long; cotyledons 4 to 6.

This species is readily distinguishable from the other species with short leaves in pairs, by the glaucous violet branchlets, which, when vigorous, develop about their middle either buds or young cones.

*P. virginiana*[2] occurs from New York and Long Island, southward, generally near the sea-coast to the Savannah river in Georgia, usually growing on sandy soil, never in great abundance, and often spreading over lands gone out of cultivation, branching in habit and of small size. It extends inland to north-eastern Alabama, central Tennessee, Kentucky, and southern Indiana, in the latter state sometimes attaining[3] on low hills as much as 100 ft. in height and 10 ft. in girth. It is of little economic value in any part of its range, the wood[4] being brittle and soft with abundant sapwood, and mostly used for firewood. It is often planted as a shade tree.

This species was introduced into England before 1739, when Philip Miller had it in cultivation at Chelsea; but, having neither useful nor ornamental qualities to recommend it, it has remained very scarce in cultivation. The trees mentioned by Loudon as existing in 1838 at Pains Hill, Dropmore, White Knights,[5] and Syon, have died or disappeared; indicating that this species is usually short-lived in England.

The largest specimen known to us is at Bayfordbury. Planted in 1842, it is now 47 ft. high, with a short butt, dividing at 2 ft. from the ground into four stems, the largest of which is 4 ft. in girth, with wide-spreading branches and sparse foliage. It bears cones freely. A tree probably planted in 1845 in the Queen's Cottage grounds at Kew is about 20 ft. high with a trunk 1 ft. in diameter, and dividing at 3 ft. up into two wide-spreading limbs. There are smaller specimens at Kew on the mound near the Lily House. (A. H.)

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[1] Galloway, in *Bot. Gas.* xxii. 437 (1896), states that in young trees the needles fall in the second year, whereas on old trees, growing on good soil, they persist for three to five years.

[2] *Pinus clausa*, Sargent, *Forest Trees*, 199 (1884), a closely allied species, growing on the coasts of Florida and Alabama, differs mainly in the ashy grey, usually clustered and reflexed cones, which remain closed on the tree for several years, before opening their scales to let out the seeds. This species is not introduced, and probably would not be hardy in our climate.

[3] Galloway, who, in *Bot. Gaz.* xxii. 433 (1896), gives an account of the ravages on this pine of a fungus, *Coleosporium Pini*, says that it attains 100 ft. high and 2½ ft. in diameter, and is the most common species around Washington, D.C., many of the abandoned fields being covered with trees 10 to 15 ft. in height.

[4] Hough, *Trees of U. States and Canada*, 17 (1907).

[5] A tree at White Knights, supposed to be this species, is *P. montana*; and a tree long labelled *P. inops* at Kew, and referred to by John Smith, in *Records of Kew Gardens*, 286 (1880), has been recognised for several years to be *P. montana*. The species cultivated on the sand-dunes of east Prussia and Denmark, sometimes known as *P. inops*, is also *P. montana*. Cf. Mayr, *Fremdländ. Wald- u. Parkbäume*, 357 (1906).

## PINUS BANKSIANA, JACK PINE[1]

*Pinus Banksiana*,[2] Lambert, *Genus Pinus*, i. t. 3 (1803); Loudon, *Arb. et Frut. Brit.* iv. 2190 (1838); Kent, Veitch's *Man. Coniferæ*, 315 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 353 (1906); Sargent, in *Bot. Gazette*, xliv. 226 (1906); Clinton-Baker, *Illust. Conif.* i. 9 (1909).

*Pinus sylvestris*, Linnæus, var. *divaricata*, Aiton, *Hort. Kew.* iii. 366 (1789).

*Pinus divaricata*, Dumont de Courset, *Bot. Cult.* iii. 760 (1802); Sargent, *Silva N. America*, xi. 147 t. 588 (1897), and *Trees N. America*, 27 (1905); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 620 (1904).

*Pinus rupestris*, Michaux f., *Hist. Arb. Amer. Sept.* i. 49, t. 2 (1810).

*Pinus Hudsoni*, Poiret, in Lamarck, *Encycl.*, v. 339 (1804).

*Pinus Hudsonica*, Parlatore, in DC. *Prod.* xvi. 2, p. 380 (1868).

A tree, attaining in America in favourable situations, 90 ft. in height[3] and 6 ft. in girth; but usually smaller, and sometimes becoming a mere shrub. Bark thin, dark brown, irregularly divided into narrow connected scaly ridges. Young branchlets slender, flexible, glabrous, greenish, turning purplish brown in the first winter and following year. Buds ovoid, pointed, covered with resin, about ½ in. long.

Leaves in pairs, the clusters not very dense on the branchlets, persistent for two or three years, spreading, 1 to 1¼ in. long, more or less curved, slightly twisted, serrulate, ending in a short cartilaginous point, with about ten stomatic lines on each surface; resin-canals median; basal sheath ⅛ to ⅙ in. long, lacerated.

Cones lateral, solitary or clustered, shortly stalked, directed towards the apex of the branchlet, much incurved, oblique at the base with the scales on the outer side most developed, ovoid-conic, 1½ to 2 in. long, yellow and shining when ripe, often remaining unopened for several years; scales thin and stiff, about ¾ in. long and ¼ to ⅜ in. broad; apophysis raised, pyramidal; umbo depressed or projecting, the minute incurved prickles of the first year usually becoming obsolete. Seeds only developed on the large scales of the outer side of the cone, triangular, blackish, ⅛ in. long; wing ⅓ in. long, broadest at the middle, full and rounded at the apex.

This species is readily distinguished by the short needles, and the occurrence of a whorl of buds, branchlets, or cones in the middle of each year's shoot when this is well-developed. The cones are peculiar in colour, shape, and direction.

This species has the most northerly range of all the pines of eastern North America, extending in Canada over a vast territory, bounded on the north by a line drawn in a north-westerly direction from northern Nova Scotia, lat. 45°, to near the southern end of Great Bear Lake, lat. 65°, not touching Hudson Bay or James

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[1] The tree is commonly known by this name in Michigan, Minnesota, and Canada. Scrub pine, Grey pine, and Black pine are also used in New England and Canada. From Quebec to Hudson Bay it is called Cypress. Banksian pine is often used in books on forestry.

[2] This is the correct name, according to the rules for botanical nomenclature adopted by the Vienna Congress. Cf. Graebner, in *Mitt. deut. dend. Ges.*, 1908, p. 68, who points out that the name *divaricata* was not accompanied by a sufficient description. Sargent now accepts *P. Banksiana* as the correct name.

[3] This is the maximum size given in *U.S. Forest Service Circ.* 57 (1907). According to Mayr, *op. cit.* 356, Macoun gives 115 ft. (35 metres) as the height which the tree sometimes attains in Canada. I have seen no exact measurements quoted, higher than those taken by me in Minnesota.

Bay; and reaching on the west the valley of the Mackenzie river and the Rocky Mountains. This pine extends southwards in the United States to Maine,[1] northern New Hampshire, Vermont, and northern New York, where it is rare and local and stunted; becoming common and of large size in Michigan, Wisconsin, and central Minnesota, and reaching its most southerly point in the northern parts of Indiana and Illinois.

In Canada, it attains its maximum size and is most abundant west of Lake Winnipeg and north of the Saskatchewan river, where it spreads over great areas of poor sandy soil, and is common and large in size in the regions north of Lake Superior.[2]

Mr. J. C. Langelier,[3] in his description of the immense forests of the province of Quebec, north of lat. 48°, where this tree is only second in importance to black and white spruce as a source of supply of sawn timber, says:—"Botanists describe Banksian pine as a stunted, short, and branchy tree. This description certainly applies not to the Banksian pine of the Lake St. John and Saguenay district, where these trees grow to a considerable height, and attain a diameter which renders them fit for saw-logs. On the Rivière au Rat in 1898, a jobber cut a tree of this kind, which gave 91 ft. of usable timber, viz. five saw-logs and two ties. This tree measured 15 in. across the stump and over 7 in. at the top. At the Escoumains Mills, they sawed for many years Banksian pine logs, turning out good boards which were exported to the United States. Banksian pine ties are from year to year coming to the front, and are transported by railway from Roberval to Quebec, a distance of 190 miles. When there will be no more cedar (*Thuya occidentalis*) to supply the enormous quantities of ties required yearly by railroads, one of its most valuable substitutes will unquestionably be found in the Banksian pine, which the northern region is in a position to supply for a very long period."

In the province of Quebec, south of lat. 48°, Banksian pine grows nearly everywhere on the poor rocky and gravelly lands, chiefly in the dry plains which have been formerly laid waste by fire. It is not so tall or so good as in the northern region, but nearly always is large enough to make railway ties. In this part of Quebec province, *P. Strobus* and *P. resinosa* are more important as sources of supply of sawn timber.[3] This pine never approaches the sea-coast, but it occupies outlying stations in the centre of Nova Scotia and of New Brunswick.[4]

In Michigan, northern Wisconsin, and central Minnesota, immense tracts of poor sandy soil are covered by Banksian pine, either pure or in mixture with red pine (*P. resinosa*). In Michigan[5] these tracts are known as Jack pine plains or barrens;

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[1] Around Lake Umbagog, in Maine, it attains a height of 60 ft.; but is usually in New England a low tree, 15 to 30 ft. high. Cf. Dame and Brooks, *Trees of New England*, 8 (1902).

[2] Bell saw large groves on Albany river, south-west of James Bay, with trees 70 ft. high and 2 ft. in diameter at the butt. Cf. *Gard. Chron.* xx. 503 (1883).

[3] *Canadian Forestry Association*, 6*th Annual Report*, 1905, pp. 64, 67, 69.

[4] *Bot. Gazette*, xxiv. 299 (1897).

[5] Cf. E. J. Hill, in *Garden and Forest*, iv. 278 (1891). In Michigan the trees are usually not more than 30 or 40 ft. high, with short scraggy trunks, and are occasionally mere shrubs. Britton, however, measured trees near Marquette on Lake Superior, 70 ft. high. Cf. *Bull. Torrey Bot. Club*, 1883, p. 82. An account of this tree on the dunes bordering Lake Michigan is given by Cowles, in *Bot. Gaz.* xxvii. 371 (1899).

and the soil, containing little or no vegetable mould, is often nothing but a shifting mass of sand. In Wisconsin, according to Roth,[1] it is always a small tree, generally less than 10 in. in diameter and below 60 ft. in height. In Minnesota, where I saw it on the Cass Lake forest reservation, it is much finer, many groves averaging over 80 ft. in height and 1 ft. in diameter, the largest tree which I actually measured being 87 ft. high and 3 ft. 3 in. in girth. These groves of pure Banksian pine, which in other localities are often many square miles in extent, consist of tall slender trees, all of the same age and very uniform in size and appearance, with a stem clear of branches to 30 or 40 ft., and a narrow crown of foliage, standing very close together on the ground, which is bare of undergrowth. Plate 289 is taken from a photograph for which I am indebted to the U.S. Forestry Bureau.

The Banksian pine not only withstands extreme cold, but even thrives in a severe climate, as is witnessed by its luxuriant development in the northern and western parts of Canada and in Minnesota. It has been successfully cultivated in the Dakotas and Nebraska[2] for shelter belts, where a better tree will not thrive; and according to Saunders[3] has succeeded when transplanted quite young, on the experimental farms at Brandon, Manitoba, and at Indian Head in the North-west Territories.

Barty and Jack say:[4]—"Timber made from it in former times when it was fairly abundant was considered to be of good size if it averaged three-quarters of a ton to a tree. The wood is hard, full of pitch, and free from sap, but apt to be full of streaks. It is much used for ties and railway sleepers, being one of the best woods for this purpose. Certain sections of country on the south-western Miramichi, the forests on which were destroyed by the great fire of 1825, have since become so thickly covered by forests of Banks's pine that it is almost impossible to force one's way through the trees."

It is specially adapted for seeding burnt areas, which have resulted from time immemorial by lightning striking dead trees. It produces cones at an early age, often when only four or five years old; and on adult trees many of the cones[5] remain for years unopened on the older branches and even on the stem, the seeds retaining their fertility for an indefinite period. These cones open their scales when scorched by fire, and disseminate large quantities of seed, usually in spring and summer, the season of the forest fires, when the seed of other species is not mature. The seedlings[6] are very rapid in growth, often attaining $1\frac{1}{2}$ ft. in height when only three years old; and once an area is covered with the seedlings of this pine, no other species can obtain a footing. This explains the occurrence of dense woods of this species, uniform in age, over large areas. After a time the growth slackens, and at 60 to 80 years ceases, so that other species, attaining a greater age and height, eventually succeed in replacing this species. (A. H.)

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[1] *Forestry Conditions of Wisconsin*, 21 (1898), published as Bull. 1 of *Wisconsin Geolog. and Nat. Hist. Survey.*

[2] Cf. *U.S. Forest Service Circ.* 57 (1907), a planting leaflet, which gives hints concerning the cultivation of this species.

[3] *Ottawa Exper. Farm Bull.* No. 47, p. 46 (1904).

[4] *Trans. Scot. Arb. Soc.* xi. p. 11.

[5] Dr. Bell, in *Canad. Forest. Assoc. 6th Ann. Report*, 1905, p. 59, states that the cones must be scorched before the seeds will escape. Many cones, however, open, like other pines, when two years old. Specimens which I collected, show that the opening of the cones is very irregular; and no explanation is forthcoming as to why some cones open and others do not. Unwin, *Future Forest Trees*, p. 83 (1905), supposes that the cones after opening, close again in damp weather. This is incorrect, as the old unopened cones contain the normal number of seeds, some of which would have escaped if the cones had opened.

[6] Schwappach, in *Anbauversuche mit fremdländischen Holzarten*, 54 (1901), gives as instances of the very rapid growth of seedlings, the average size of two-year-old plants, 8 in.; five years old, 5 ft.; nine years old, 10 ft. It is incorrectly stated that it makes two or three shoots in a year; the two or three whorls of branches produced are all formed in the winter bud, and appear on the first and only shoot of the season.

### CULTIVATION

The date of introduction of this tree into Great Britain is unknown, though Aiton says that it was in cultivation before 1783.

Lambert described it in 1803 from a tree growing at Pains Hill which had probably been planted by the Hon. Charles Hamilton, who founded that place before 1735,[1] and which he describes as a remarkably fine tree, though he gives no measurements. He also mentioned trees then growing at Kew and at Croome in Worcestershire. All these[2] had disappeared when Loudon wrote, and he says that a tree at Dropmore, which in 1837 was 27 ft. high and 1½ in. in diameter, was then the finest known to him. There was also one at White Knights 30 ft. high. Neither of these is still alive, and we have found only a few trees now living in England besides those at Kew. One growing at Arley Castle, which is the only survivor of five or six planted there probably about 70 years ago, measured in 1909, according to Mr. Woodward, 45 ft. by 3 ft. 3 in. Another at Nuneham Park, Oxford, covered with cones, and apparently having attained its maximum height, was 44 ft. by 4 ft. 7 in. in 1907. Another at Pencarrow measured by Mr. A. Bartlett in 1906 was 35 ft. by 3½ ft.; and there is a poor stunted tree bearing cones at Menabilly. A specimen at G. Paul's Cheshunt Nursery, is about 30 ft. high by 3 ft. 4 in. in girth. Mr. Paul says it was probably planted in 1845-1850, and remembers it in 1860 nearly as tall as it is now.

All these facts show that this species is likely, from an economic point of view, to be worthless in this country, as might be expected, considering that the tree inhabits a climate unlike that of any part of Britain. Nevertheless, several writers have strongly recommended this tree for planting in England on the strength of a very short experience on the barren sands of northern Germany,[3] where the tree, growing very rapidly from seed, has been widely puffed by enterprising nurserymen, and where it may possibly be useful for shelter in places where nothing better will grow. I was seriously advised by an expert in forestry to plant it on a large scale, and might have done so if I had not previously known the tree in its own country.

Dr. Mayr of Munich, whom I consulted before utterly condemning the tree, and who is second to none in his knowledge of the trees of the northern hemisphere, agrees with me that, if planted at all, it is only fit for the worst class of sandy soil; but as young plants can now be procured at a cheap rate in Germany, there will be no harm in trying a few as an experiment on dry poor soils on the mountains of eastern Scotland. Mayr's account, in his recent work, of the favourable results obtained by the cultivation of this tree in Germany should be studied by those who wish to try it; but he recommends it only as a sheltering and improving crop for the worst kinds of sand and gravel soil in places which suffer severely from spring frost, and where nothing better will grow. He does not expect it to produce valuable timber. Its growth is remarkably fast when young, and it produces good seed when only fifteen years old.

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[1] Loudon, *op. cit.* i. 70.

[2] Loudon, in *Gard. Mag.* xviii. 585 (1842), mentions a *P. Banksiana*, 14 ft. high, at Dalhousie Castle, where many American trees had been introduced by the Earl of Dalhousie when he was Governor of Canada.

[3] In Bavaria, according to Mayr, over 500,000 have been planted in the State forests, and one firm in Germany sold 6,000,000 plants in 1905. The tree has also been planted extensively at Römershof, near Riga, and experiments are now being made with it on the sand dunes of Jutland.

Of these recent introductions, Dr. Mayr showed me, in May 1905, a tree growing at Grafrath, near Munich, from seed brought from Wisconsin in 1885. It was 20 ft. high, and bore fertile cones. (H. J. E.)

## PINUS PINASTER, MARITIME PINE

*Pinus Pinaster*,[1] Solander, in Aiton, *Hort. Kew.* iii. 367 (1789); Loudon, *Arb. et Frut. Brit.* iv. 2213 (1838); Lawson, *Pinet. Brit.* i. 71 (1884); Willkomm, *Forstliche Flora*, 233 (1887); Mathieu, *Flore Forestière*, 610 (1897); Kent, Veitch's *Man. Coniferæ*, 358 (1900); Kirchner, *Lebensgesch. Blütenpfl. Mitteleuropas*, 238 (1905); Clinton-Baker, *Illust. Conif.* i. 43 (1909).

*Pinus maritima*, Lamarck, *Flore Franç.* ii. 201 (1778); Poiret, in Lamarck, *Encycl.* v. 337 (1804); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 621 (1904).

*Pinus syrtica*, Thore, *Prom. Gascogne*, 161 (1810).

*Pinus Lemoniana*, Bentham, in *Trans. Hort. Soc.* i. 512 (1835).

*Pinus Hamiltoni*, Tenore, *Cat. Hort. Neap.* 90 (1845).

A tree attaining 120 ft. in height and 14 ft. in girth. Bark soon becoming scaly and furrowed; on old trees deeply fissured and broken up into scaly plates, dark-brown externally, and reddish internally. Young branchlets brown, glabrous, with raised keeled pulvini; older branchlets, from which the leaves have fallen, roughened by the pulvini, bearing at their apices the reflexed bases of the scale-leaves; the bases of the shoots surrounded by a sheath of reflexed bud-scales. Buds ¾ to 1 in. or more, stout, spindle-shaped, pointed; scales brown, interlaced by their white fimbriated margins, and with free and reflexed points.

Leaves in pairs,[2] persistent usually for three years, slightly spreading, 5 to 6 in. long, stout, rigid, curved, ending in a callous point, serrulate, with numerous stomatic lines on both surfaces; resin-canals marginal; basal sheath an inch long, persistent.

Staminate flowers in a dense spike. Young cones ¾ in. long, brownish red, with non-prickly scales, on a scaly peduncle, about ½ in. long. Mature cones,[3] subterminal, in a whorl[4] of 2 to 8, shortly stalked, spreading or much deflexed, ovoid-conic, 3 to 7 in. long, 1½ to 2½ in. in diameter near the oblique base, shining reddish yellow; scales oblong, about 1½ in. long and ¾ in. broad, flat; apophysis rhomboidal, convex and slightly raised in the centre, or pyramidate and much elevated, with a linear transverse ridge, and a dull grey elevated sharp-pointed or blunt umbo. Seed ⅓ in. or more, shining black above and dull mottled grey below, with a detachable brown wing, 1 to 1½ in. in length.

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[1] This is the oldest certain name, and the one almost universally adopted. *P. maritima*, Miller, *Gard. Dict.* Ed. 8, No. 7 (1768), is insufficiently described, and has been referred to both *P. Pinaster* and *P. Laricio*. Cf. Graebner, in *Mitt. d. dend. Ges.*, 1908, p. 68.

[2] They sometimes occur in clusters of threes on young trees.

[3] The cones in France usually open and let out the seed in the spring of the third year; but in Corsica and Spain I observed many trees, with cones unopened and five to twelve years old. Here also trees begin to bear cones very early, which remain unopened in numerous whorls on the main stem, resembling exactly the trees of *P. tuberculata* in the Siskiyou mountains. One tree, 10 ft. high, had seven whorls of cones, the upper five of which, two to six years old, were unopened. Another tree twenty-two years old bore cones in twelve whorls on the stem, all unopened. This is undoubtedly an adaptation for regeneration on burnt areas, due to the frequent fires in these dry regions.

[4] Mr. H. Clinton-Baker obtained in 1908 from a tree at Boldre Grange, Lymington, a branch with sixty-one small cones in a cluster.

The seedling has seven or eight cotyledons, entire in margin and dull green in colour; and the stem is clothed during the first two years with solitary sharply serrate primary needles, the adult geminate foliage only appearing in the third year. Seedlings thrive only in full sunlight, and grow fast, attaining often a foot in height in the first year, and 10 to 12 ft. at the end of the tenth year. This pine[1] has a strong tap-root, but speedily develops in addition lateral roots which either spread horizontally or descend into the soil.

### VARIETIES

This species varies, in the wild state, in the length of the leaves and in the size of the cones,[2] the scales of which show considerable differences in the amount of prominence of the apophyses. The following varieties have been distinguished.

1. Var. *Aberdoniæ*, Loudon, *Gard. Mag.* xv. 128 (1839). Leaves pale green. Cones shorter and more ovoid than in the type. Introduced in 1825 from Nice by the Earl of Aberdeen, who raised plants, one of which was presented to Lord Granville, and was reported by Loudon to have been 17 ft. high at Dropmore in 1837. Reported trees of this variety, labelled *P. Escarena*,[3] are now growing at Dropmore, and only differ from the type in having a thinner and less fissured bark.

2. Var. *Hamiltoni*, Gordon, *Pinetum*, 178 (1858) (*Pinus Hamiltoni*,[4] Tenore, *Cat. Ort. Bot. Nap.* 90 (1845)), is supposed[5] to be identical with the preceding variety; but a tree at Kew, named var. *Hamiltoni*, only differs from the type in having more slender branchlets. It has not borne cones.

3. Var. *minor*, Loiseleur, in *Nouv. Duhamel*, v. 242, t. 72 (1812), found on barren sands near Le Mans, France, was said to bear small cones, and to be hardier than the type.

4. Var. *Lemoniana*, Loudon. *P. Lemoniana*, Bentham, in *Trans. Hort. Soc.* i. 512 (1835). Cone solitary and erect at the end of the branchlet, the terminal bud not

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[1] After felling, the stools occasionally grow, like those of the silver fir, and for the same reason, because their roots are connected with those of adjacent living trees. The annual rings of wood continue to be formed on the stump after the trunk has been felled, as illustrated by a specimen from Gordon Castle; and this new formation in the amputated stump owes its origin to inosculation of the roots. A remarkable example of the fusion of the roots of two trees of *P. Pinaster*, discovered in a Portuguese forest, and now preserved in the Museum at Coimbra, is illustrated in *Gard. Chron.* xxii. 300, fig. 58 (1884).

[2] Cones of this species, differing in the arrangement of the scales, are described and figured by Dickson, in *Trans. Roy. Soc. Edin.* xxvi. 505, Pl. 19-22 (1871). At Woburn the cones of old trees growing close together vary considerably in the prominence of the apophyses, and in the size of the seeds; but seedlings raised from the two kinds of seed are indistinguishable in appearance at present.

[3] *P. Escarena*, Risso, *Hist. Nat. Europ. Mérid.* ii. 340 (1826), is a doubtful plant; and according to the Duke of Bedford, *ex* Loudon, *Gard. Mag.* xv. 127 (1839), is a variety of *P. sylvestris*. The seeds brought home by the Earl of Aberdeen from trees near Nice were erroneously supposed by him to be Risso's species, which was named *P. Escarena* in honour of the Count d'Escarène, who discovered it wild in the mountains near Nice. Gordon, in *Gard. Chron.*, 1841, p. 564, gives an inaccurate account of this, which he calls *P. ascarena*, from a village named Ascaren in Italy.

[4] A tree labelled *P. Hamiltoni* still exists in the Botanic Garden at Naples, of which Prof. Cavara has kindly sent us a branch with cones, which are indistinguishable from those of typical *P. Pinaster*.

[5] By Gordon, and by Koch (*Dendrologie*, ii. 2, p. 292 (1873)).

developing.[1] This variety was first observed by Sir C. Lemon; and in Loudon's time there were numerous examples at Carclew, the largest being about 30 ft. high in 1837. It was reported to come true from seed. When Elwes visited Carclew in 1905 there was only one survivor to be found, a poor scrubby tree in a hedgerow, and covered with ivy, a specimen from which shows the peculiarity in the position of the cone.

5. Hybrids[2] between this species and *P. halepensis*, twenty to forty years old, obtained by sowing seed of trees of the former species at Mirabeau, Vaucluse, show a grey bark like that of *P. halepensis*, and leaves 4 in. long, thinner than those of *P. Pinaster*.

### DISTRIBUTION

The maritime pine is a native of the Mediterranean region, extending as far eastward as Greece, and reaching the shores of the Atlantic in France and Portugal. *P. Pinaster* and *P. halepensis* have a somewhat similar distribution, but they occur on different soils, the former usually occupying siliceous sands, and the latter occurring on limestone. The maritime pine is usually confined to the coast regions and islands, seldom extending far inland.

It forms extensive woods in western Portugal; and in Spain, occurs in Galicia, Estremadura, and the eastern parts of Granada. North of Gibraltar it grows in mixture with *A. Pinsapo* on the Sierra de Bermeja, elsewhere forming scattered pure woods of no great extent, the largest trees which I saw being about 10 ft. in girth.

In France it is a native of Gascony, where small woods, called *pignadas*, undoubtedly occur in the wild state; but its natural area has been much increased by plantations, the artificial forest of this species in the Landes between Bordeaux and Bayonne being perhaps the most extensive ever created by the hand of man. The total extent of the *Pignada Landaise* amounted in 1892 to 1,715,000 acres, of which 1,600,000 acres belong to communes and private owners, the remainder comprising the dunes on the coast, which cost the government immense sums in various works. The total expenses of planting, road-making, etc., of the 1,600,000 acres is estimated to have been £2,100,000. The value of this forest was £8,200,000 in 1877, which had increased, according to Mr. Huffel,[3] to £18,000,000 in 1904, the annual revenue obtained by the sale of timber, turpentine, and resin being £560,000, or 7s. per acre. Recent improvements in transport, such as the construction of light railways, have raised the annual returns considerably. The greater part of this immense area has been planted subsequently to 1855, as in that year the total area under *P. Pinaster* was only 50,000 acres.

This species is also found[4] in the Mediterranean region of France, in the mountains of the Maures and Estérel, and in the Albères, but here it rarely occurs pure, and is a smaller tree than in the Landes. It has also been planted in France far to the north of its natural habitat, up to latitude 49° in Brittany. Nearly 200,000 acres were planted with this species in Sologne in the centre of France, but most of the trees here were killed by the severe winter of 1879, and *P. sylvestris* has been planted in its place.

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[1] Masters, in *Journ. Roy. Hort. Soc.* xiv. 237 (1892), says that he twice met with a similar condition in *P. sylvestris*.

[2] *Pinus halepensi-Pinaster*, Saporta, in *Comptes Rend. Acad. Sc. Paris*, cix. 656 (1889). Cf. Ascherson and Graebner, *Syn. mitteleurop. Flora*, i. 232 (1896).

[3] *Économie Forestière*, i. 177 (1904).

[4] Fliche and Grandeau, in *Ann. Chimie et Physique*, 383 (1873), found that in Champagne it only throve on sand, loam, or clay containing less than 0·35 per cent of carbonate of lime, and became stunted and died on chalk soils. Yet it is frequent near Nice on limestone, according to Bunbury, *Bot. Fragments*, 7 (1883); and Mr. Tansley has lately found it on the Riviera flourishing in mixture with *P. halepensis*, in soil which effervesced freely when acid was applied close to the roots.

In Corsica it occurs from the sea-coast up to 2700 ft. on northern aspects, and to 4000 ft. on southern slopes, mixing in its upper level with *P. Laricio*, and often becoming a fine tree, the largest which I measured in the mountains near Calvi, at 3000 ft. altitude, being 100 ft. high and 10 ft. 10 in. in girth, with a stem clear of branches to 50 ft. (A. H.)

In Portugal this is perhaps the most abundant tree in all the coast region; and on poor sandy soil unfit for agriculture, covers immense areas, mixed to a small extent with oaks on the better land, but generally pure, and reproducing itself freely everywhere. The trees are seldom allowed to grow very large, the tallest that I saw on deep sand near the Oporto coast being about 100 ft. high and 5 or 6 ft. in girth. But in the Royal forest near Leiria a tree, in 1843, measured 39 metres by 4·48 metres; and in the same forest in the Canton d'Alvenha two trees then existed, of which the first was 40 metres by 3 metres, with a clean bole 27 metres long; the second 38 metres by 4·20 metres. In the forest of Busaco on granite soil there are a few trees scattered among the oaks, of which the largest that I measured was 80 ft. by 9 ft. 4 in. The bark was here not so red and shining as on old trees in England, but quite easy to distinguish from the greyer bark of *P. Pinea*. *P. Pinaster* is known in Portugal as *Pino bravo* or wild pine, whilst *P. Pinea* is called *Pino manzo* or cultivated pine. It grows wild up to about 2500 ft., and was being sown on the hills above Caldas do Gerez, in the Gerez mountains north-east of Oporto, up to about 3000 ft. on dry slopes, where the soil was not good enough for oak.

In Italy this species appears to be limited to the west of the Apennines, on the sandy plains and in the lower hills, from Savona and Genoa[1] to Mount Argentaro. On the eastern side of the Adriatic it occurs on the islands of Lussin, Brazza, Lesina, and Curzola, where it is a tree of moderate height, resembling the Austrian pine in habit. It occurs also in Greece. In Algeria[2] it is only known on the hills overlooking the coast, between Bougie and Cape Bougarone, where it covers an area of about 4000 acres.

In Cape Colony, where it has been introduced, it grows like a weed along the southern coast, where there are winter rains, and is now largely planted for railway sleepers and firewood by the Forestry Department.[3] At Port Phillip, in Victoria, Australia, it averages 40 ft. high in 20 years.[4] It is also largely planted in the Madeiras and Canaries.

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[1] According to Bunbury, *loc. cit.*, it grows on serpentine in the hills between Savona and Genoa, and between Sestri and Spezia.

[2] Lefebvre, *Les Forêts de l'Algérie*, 432 (1900).

[3] Hutchins, in Flint and Gilchrist, *Science in S. Africa*, 393 (1905).

[4] Von Mueller, *Select Extratropical Plants*, 360 (1891).

## CULTIVATION

The maritime pine was introduced by Gerard more than three centuries ago, and though it has at various times been very largely planted in some parts of England, it has never taken the place of a forest tree, and has no qualities which will justify its being considered as such, except in a few places.

It seems, however, so much at home[1] on the warm sands of south-east Dorsetshire, where it reproduces itself freely by seed, that it might perhaps take the place of Scots pine for pit props in places where sea carriage is available. On the road from Christchurch to Heron Court it attains a very large size. The best I measured was about 85 ft. by 9½ ft. on almost pure sand among rhododendrons and tall bracken. I could not learn, however, that the timber was valued here, and was unable to find out the age of the trees.

Though the tree is a native of the Mediterranean region, it seems able to endure great extremes of wet and cold in this country, as I have seen it growing well in the damp climate of Wigtownshire and on the sandhills of Norfolk.

We have measured a great many adult trees in various parts of England, among which a tree (Plate 290) near the house at Foxley Hall, near Hereford, is one of the finest, measuring, in 1907, 95 ft. by 11 ft. 8 in. with a bole clean to 50 or 60 ft. This was remarkable, because the soil and climate at Foxley seem to be more suitable to oaks than to maritime pines, though the situation is well drained and sheltered.

In the grounds of the Earl of Mount Edgcumbe at Mount Edgcumbe, Cornwall, Mr. A. B. Jackson measured an immense old tree, which in 1909 was 18 ft. in girth.

In the kitchen garden at Penrhyn Castle, there is a remarkable tree 80 ft. high and forked close to the ground, forming two huge trunks 11½ ft. and 8 ft. 10 in. in girth, between which a large aviary is fixed.

Other large trees are as follows:—

| | Height. | Girth. | Year. | By whom measured. |
|---|---|---|---|---|
| Arno's Grove, Middlesex . . | 90 ft. | 8 ft. 10 in. | 1906 | A. Henry. |
| Buxsted Park . . . . | 96 ft. | 12 ft. 5 in. | 1908 | H. J. Elwes. |
| Burwood House, Surrey . . | 75 ft. | 8 ft. 10 in. | 1909 | Col. H. Thynne. |
| " " " . . | 78 ft. | 7 ft. 10 in. | " | " " |
| Ashburnham Park, Sussex . . | 80 ft. | 10 ft. (about) | " | H. A. James. |
| Holwood, Kent . . . . | 85 ft. | 8 ft. 7 in. | 1890 | A. D. Webster. |
| Stackpole Court, Pembroke . . | 80 ft. | 7 ft. 6 in. | 1906 | H. J. Elwes. |
| Dropmore, Bucks[2] . . . | 75 ft. | 10 ft. 9 in. | 1910 | C. Page. |
| High Canons, Herts . . . | 69 ft. | 7 ft. | 1908 | H. Clinton-Baker. |
| Hatfield Park, Herts . . . | 65 ft. | 11 ft. 5 in. | 1905 | A. Henry. |

At Westwick, Norfolk, according to Loudon, who quotes the *Trans. Soc. Arts*, xxviii. 37 (1811), J. B. Petre, Esq., planted in 1809, on upwards of 500 acres, over 200,000 trees raised from his own seed from trees planted about 1702. I am informed by Mr. M. P. Price that in March 1909 he measured roughly some of the largest surviving trees, and found them to be from 75 to 80 ft. high by 9 to 10 ft. in girth, the boles having very thick bark, and tapering considerably. The tallest tree was found by Henry in 1910 to be 93 ft. by 5 ft. Most of the trees were blown down in the gale of March 24, 1895, the survivors being now scattered among Scots pines which were planted with them. There is no natural reproduction, as the squirrels eat every seed as soon as it is ripe. The present owner, Major B. J. Petre, states that the timber is inferior to that of Scots pine, rarely selling for more than 4d. per foot, while the latter is readily saleable at 6d.

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[1] Cf. Clement Reid, *Origin British Flora*, 12 (1899). Boswell Syme, *Eng. Bot.* viii. 270 (1868), erroneously states that it is a native of the south of Ireland.

[2] A tree labelled *P. Escarena*, planted in 1841, measured 66 ft. by 8 ft. 3 in. in 1909.

On the sandhills at Holkham this pine has been planted to some extent, and reproduces itself from seed, but does not grow so well as *P. Laricio*.

In Scotland, the finest tree we know is one[1] growing in a wood at Monreith, Wigtownshire, which measured 82 ft. by 9½ ft. in 1905. At Smeaton-Hepburn, East Lothian, there are three trees in a wood, about 70 ft. high by 6 ft. in girth.

In Ireland the best tree which we have seen is at Curraghmore, Waterford, and measured 91 ft. by 7 ft. 10 in. in 1907. At Castlemartyr, Cork, there is a good tree, 70 ft. by 9 ft. At Powerscourt, Wicklow, a tree 67 ft. by 9 ft. 11 in. was bearing cones profusely in 1906. Capt. John Campbell reports that in an exposed position on peat bog, near Moycullen, Galway, this species is thriving; and it appears to have been the only tree that survived in the disastrous experiment of planting on peat bog at Knockboy. At Shelton Abbey, Co. Wicklow, there are four trees, growing in a sheltered situation on a gravelly bank, the dimensions of which, as given by Mr. Shivas in 1910, are 60 ft. by 10 ft., 80 ft. by 8 ft. 9 in., 50 ft. by 9 ft. 8 in., and 60 ft. by 7 ft. 9 in. At Tullymore, Co. Down, there is a fine old tree in the same valley where the Silver firs (Plate 211) grow. Being crowded among other trees, I could not measure its height, which I estimated at 75 ft.; the bole, 10½ ft. in girth, was clean to 40 or 50 ft. up.

### TIMBER

The timber of this tree is one of the most important articles of export from the south-west of France. Of late years great quantities of pit props have also been exported from Portugal to South Wales, and as their local value is very small, and the cost of transport to the shipping ports low, this source of supply cannot be overlooked in considering the probable future value of pit props in our southern counties.

An account of the uses of this tree, quoted from a French author, was given by Loudon in 1838, which is worth reading, though perhaps rather out of date. Resin seems then to have been the most valuable product of the tree, but lamp-black was also an important item, and the methods of extracting both are fully described. Now, however, a great quantity of the trees after having been tapped until their resin is exhausted, are shipped in the form of pit props to the South Wales coal ports at a very low rate of freight, in the coal ships, which would otherwise return empty from Bordeaux; and are delivered on the wharf in suitable lengths, in such quantities, and at such a low price, now 20s. to 21s. per ton, that they govern the price of home-grown mining timber. It has been pointed out by Mr. R. Anderson of Cirencester in a paper on the conversion of home-grown timber,[1] that British timber is further handicapped by the railway companies' practice of giving lower rates for carriage of pit props to the collieries from these landing ports, than they do for English timber over the same lines of railway from inland stations. He calculates that this preferential rate may mean a disadvantage of £12 : 10s. per acre as compared with foreign timber. Mr. Anderson tells me that in consequence, as he believes, of these disadvantages, he has seen no home-grown pit props or English timber in the Derbyshire collieries; and on more than one occasion when I have tried to sell timber to coal owners in that district, I have found that Norwegian timber from the north-east ports was delivered at a price which, after paying haulage and railway charges over about the same distance, would make it impossible for me to grow such wood profitably.

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[1] Figured in *Woods and Forests*, 1884, p. 737.

(H. J. E.)

## PINUS PINEA, Stone Pine

*Pinus Pinea*, Linnæus, *Sp. Pl.* 1000 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2224 (1838); Schouw, in *Ann. Sci. Nat.* iii. 236 (1845), and *Journ. Hort. Soc.* iii. 120, 130 (1848); Willkomm et Lange, *Prod. Fl. Hispanica*, i. 20 (1861); Laguna, *Fl. Forestal Española*, 49 (1883); Boissier, *Fl. Orientalis*, v. 694 (1884); Fliche, *Assoc. Franç. Avance. Sciences, Nancy* (1886); Willkomm, *Forstliche Flora*, 240 (1887); Mathieu, *Flore Forestière*, 620 (1897); Kent, Veitch's *Man. Coniferæ*, 360 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 613 (1904); Clinton-Baker, *Illust. Conif.* i. 44 (1909).

*Pinus fastuosa*, Salisbury, *Prod.* 398 (1796).

*Pinus maderiensis*,[2] Tenore, *Ind. Sem. Hort. Neap.* in *Ann. Nat. Sci.* 379 (1854).

A tree, attaining 100 ft. or more in height, with a trunk rarely 20 ft. in girth, and a broad rounded head of ascending branches and very dense foliage. Bark at first smooth and brown, ultimately deeply furrowed and scaly. Young branchlets glabrous, yellowish green, with raised keeled imbricated pulvini, terminating in lanceolate fringed reflexed scale-leaves, which persist during the first year. Buds $\frac{1}{4}$ to $\frac{1}{3}$ in. long, ovoid, pointed; scales brown, matted together by the long white fimbriæ on their margins, free and reflexed at their apices.

Leaves in pairs,[3] persistent two years, densely crowded on the branchlets, spreading, 4 to 5 in. long, curved, serrulate, sharp-pointed, marked with about twelve stomatic lines on the outer and six on the inner surface; resin-canals marginal, numerous; basal sheath whitish, $\frac{4}{10}$ in. long.

Cones sub-terminal, solitary or two or three together, on stout stalks, which are clothed with scale-leaves and $\frac{1}{2}$ in. to $\frac{3}{4}$ in. long; erect, ovoid or nearly globular, 4 to 6 in. long, and 4 in. broad, symmetrical, shining and light brown; scales $1\frac{1}{2}$ in. or more in length, $\frac{3}{4}$ in. wide, hollowed at the base for the seeds; apophysis much thickened, pyramidate, four to five angled, and marked with four or five radial linear ridges; umbo rhomboidal, $\frac{1}{3}$ in. wide, dark coloured, showing in its centre an inner umbo, which is often tipped with a triangular reflexed process. Seeds[4] numerous, nearly 100 in a cone, one or two on each scale, ⅝ in. to ¾ in. long, dark purplish brown, convex on the inner and flattened on the outer surface, with a thick shell and an edible kernel; wing ⅛ in. to ¼ in. long, surrounding the apex and part of the sides of the seed, remaining on the scale when the cone opens.

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[1] *Journ. Roy. Agr. Soc. England*, lxiv. 50 (1903).

[2] Cf. *Gard. Chron.*, 1855, p. 334.

[3] On well-developed vigorous branches, a few of the leaves are sometimes in clusters of threes.

[4] Seeds kept in the cones apparently retain their germinating power indefinitely, an instance being recorded in *Gard. Chron.*, 1856, p. 39, where seedlings were raised from cones said to be forty years old.

The cones of this species are remarkable in taking three years to ripen, the seeds usually falling out in the spring of the fourth year; and each scale shows distinctly the growth of three seasons, the inner and outer umbo indicating the growth of the first and second year, while the rest of the apophysis is formed in the third year.

The seedling[1] has ten to thirteen cotyledons, nearly 2 in. long, triangular in section, sharp-pointed and stomatiferous on the upper two sides. The primary leaves, solitary, ½ to 1 in. long, linear, flattened, serrate, and stomatiferous on both surfaces, are produced for several years, in mixture, after the first season, with the adult geminate leaves. Seedlings are very vigorous in growth, often attaining a foot in length in six months, and develop lateral branches and a long tap-root.

In this species,[2] adult trees frequently produce branches, which bear solitary glaucous flat linear leaves, similar to the primary leaves on the seedling plant. Hochstetter[3] has succeeded in fixing the juvenile form by cuttings, producing beautiful shrubs with solitary needles.

The Comte de Paris sent in 1894, from his estate near Seville in Spain, to the Museum at Kew,[4] a cone, from the apex of which a stout leafy shoot had sprung, a foot in length and with three branches. It died after it had exhausted all the nourishment from the cone, which had been severed from the tree when the shoot was about 6 in. in length.

The stone pine shows little or no tendency to vary; but there is a form in cultivation in Italy, var. *fragilis*, with a very thin shell to the seed.

## DISTRIBUTION

The stone pine is a native of the Mediterranean region, and undoubtedly occurs wild,[5] as well as planted, in the Iberian peninsula, south-eastern France, Corsica, Italy, Greece, and Asia Minor, extending a little distance into Russian territory on the south-east of the Black Sea. It has been recorded as a native of the Canaries and Algeria, but there is no doubt that it has been introduced into these regions. It has been extensively planted for centuries, and it is difficult to ascertain whether existing woods are natural or artificial in many localities; while on the other hand, owing to the advance of agriculture, it has probably disappeared in historic times from many places.

It is more widely distributed in Spain and Portugal than elsewhere, its northern limit, according to Willkomm,[6] being a line following the Douro from its mouth to its source, continued through southern Aragon to the coast of Catalonia. Remarkable woods occur at Albufeira in Algarve, and on the shores of the Bay of Cadiz. It ascends in the mountains of the coast region of Granada to 3000 ft., an elevation unattained elsewhere, as it is usually a native of the plains and low hills near the sea. (A. H.)

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[1] Excellent figures representing different stages in the germination are given by Sachs, *Text-book Bot.* 508 (1882).

[2] Cf. Masters, in *Gard. Chron.* xx. 48, fig. 9 (1883), and *Journ. Linn. Soc.* (*Bot.*) xxvii. 259, fig. 8 (1891).

[3] *Gard. Chron.* xv. 333 (1881).

[4] Thiselton-Dyer, in *Ann. Bot.* xvii. 779, t. 40 (1903), and *Kew Bulletin*, 1894, p. 226.

[5] Nyman, *Syllog. Fl. Europ.* 347 (1854-5), doubts the spontaneity of this tree in Europe; but this opinion is contrary to that of most botanists.

[6] *Pflanzenverb. iber. Halbinsel*, 96 (1896).

In Portugal the stone pine is not nearly so common a tree as the maritime pine, and is usually seen on dry hill-sides and exposed places, where its umbrella-shaped crown makes it a very conspicuous tree. The finest that I saw was a very remarkable tree near Covilha in the province of Beira Baixa, growing at an elevation of about 2000 ft. Padre J. de Silva Tavares lent me a splendid negative of this tree, reproduced on Plate 291, and informed me that its height was 31·25 metres, the girth of the trunk, which is 14½ metres high, being 5·36 metres at the base. He said that an old man, who remembered the French invasion, stated that it was then about the same size as at present, so the tree must be a very long-lived one. On the Pena Verde, near Cintra, I measured another fine old tree of very gnarled and rugged habit, owing to its exposed situation. It was about 75 ft. high, with a trunk of about 30 ft. by 12 ft., the bark divided into very broad reddish plates, which do not become smooth and shining like those of *P. Pinaster*. Both of these are exceeded in size by a tree said to have been cut down at Curto,[1] which measured 40 metres by 6·40 metres. A section of this tree, 4·77 metres in girth, showed 300 annual rings. (H. J. E.)

In France isolated trees are met with in the forests of Aleppo and maritime pines in the extreme south of Provence and Languedoc; and nearly pure woods, which are undoubtedly wild, occur on several points of the Mediterranean, from Aigues Mortes to Cannes. The largest of these, 750 acres in extent, lies between Aigues Mortes and Les Saintes. Another wood at La Plage, near Hyères, is 160 acres in area. Others occur at Vidauban, Saint Raphael, and between Cannes and Napoule. The most northerly station in France is the remarkable forest of Bigourdin near Fonscolombe, which consists of a mixture of *P. Pinea* and *P. halepensis*, and is undoubtedly natural. Here the mean annual temperature is 58°, the same as at Ravenna, the northern limit of the tree on the Adriatic. The most remarkable specimen is the *Pin de Bertaud*,[2] growing in the department of Var, two miles from Saint-Tropez, on the main road to Toulon. It is 53 ft. high, well shaped, and with a perfectly sound trunk 20 ft. in girth, the spread of foliage being 85 ft. in diameter. In France the stone pine is cultivated as far north as Angers, which has a western mild climate.

In Corsica there is a wood of this species, about 25 acres in area, near Porte Vecchio.

In Italy *P. Pinea* is wild at intervals on the west coast, from Genoa, where it occurs on the low hills, to Ostia, mainly growing on sandy plains in mixture with *P. Pinaster*. The natural forest of San Rossore, between Leghorn and Pisa, in which *P. Pinea* predominates amidst *P. Pinaster* and broad-leaved trees, like *Quercus pedunculata* and *Q. Ilex*, with an undergrowth of *Erica scoparia* and grasses, occurs on soil containing very little lime, less than ½ per cent. The pines attain a height of about 70 ft. There is also a wood of this species at Castel Fusano near Rome. The most celebrated forest[1] of *P. Pinea* in Italy, the *Pinete di Ravenna*, in which Dante, according to tradition, composed the *Divina Commedia* whilst he walked amidst its glades, is situated east of Ravenna, forming a band 2 miles distant from the Adriatic coast, about 16 miles in length and a mile in width; and in 1866 covered about 10,500 acres, according to Balestreri,[2] who visited it in that year, when the pines were about 60 ft. in height and 8 ft. in girth. There are three distinct sections,—the *Pineto di S. Vitale*, about 5000 acres, and the *Pineto di Classe*, about 2500 acres, which belong to the city of Ravenna; while the third, the *Pineto di Cervia*, about 3000 acres, is owned by the commune of Cervia. This forest was greatly damaged[3] by the long and severe winter of 1879, when the thermometer fell to – 10° or – 12° C., all the young pines, less than twenty-five to thirty years old, being killed outright. The older trees, with their foliage brown and withered in the spring of 1880, were believed to be dead; and orders were given to fell them and sell the timber. A large area was at once completely cut down. Later in the season, the trees were observed to be still living, and the destruction was stopped. About 2700 acres remained untouched, and the old trees here are now thriving. About 5000 acres of the area which had been felled, was subsequently sown with seed; and the young pines are now flourishing and about 15 to 25 ft. in height. For the preceding information we are indebted to M. Bandi, the forester in charge, whom I saw in 1909, when I visited the *Pineto di Classe*, which lies about 5 miles south-east of Ravenna. The soil is sandy, but is said to contain a notable quantity of lime, nearly five per cent. The forest is an open one, mainly composed of pines with a few scattered oaks (*Q. pedunculata*), and an undergrowth of *Cratægus Pyracantha*, *Rosa sempervirens*, clematis, juniper, and bracken. Towards the margin, where the soil improves, the pines become fewer, and are replaced by oak and *Fraxinus oxycarpa*. The largest pines which I saw measured 70 to 80 ft. in height and 5 to 7 ft. in girth.

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[1] Gebhart, in *Rev. des Eaux et Forêts.*

[2] *Journ. Soc. Nat. Hort. France*, 1888, p. 367, fig. 1.

In Italy the tree is cultivated for its edible seeds from the foot of the Alps to Sicily, and is planted from sea-level up to 1000 ft. in the north and 2000 ft. elevation in the south. The timber, which was formerly used for shipbuilding, is no longer employed.

According to Beck v. Mannagetta[4] it is scarcely wild on the eastern shore of the Adriatic, and is even rarely planted, and only for ornament. Boué's observation that it occurs in Herzegovina near the sea has not been confirmed; and Poscharsky's statement that it forms woods at Ragusa is erroneous.

In Greece it is recorded[5] at many stations on sandy soil in the plains and on the low hills, in Attica, Peloponnesus, and in the islands of the Cyclades, Crete, Cephalonia, Zante and Corfu. It is common[6] in the islands in the Sea of Marmora, and the seeds are called *fistik* by the Turks.[7]

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[1] It was described by Ginanni, in a large book published at Rome in 1774, entitled *Istoria Civile et Naturale delle Pinete Ravennati.*

[2] *Pinete di Ravenna.* (Florence, 1866.)

[3] In *Gard. Chron.* xv. 736 (1881), and *Woods and Forests*, i. 146 (1884), there are accounts of this calamity.

[4] *Veget. illyrischen Länd.* 185 (1901).

[5] Halacsy, *Consp. Fl. Græcæ*, iii. 451 (1904).

[6] Walsh, in *Trans. Hort. Soc.* vi. 47 (1826).

[7] In Cyprus it is sometimes planted, but Mr. Hutchins thinks that it is not indigenous.

Boissier records it in the littoral region of Anatolia and Syria; and it reaches its most easterly point as a wild tree on the left bank of the Tschoroch river, near Artun, south of Batoum, where it forms an open wood in mixture with *Arbutus Andrachne*.[1]

It does not appear to be wild in northern Africa, and forms no part of the flora of Egypt, though two cones were found in a tomb of the 12th dynasty (2200-2400 B.C.), which are now preserved in the museum at Boulac.

A cone has been found in a turf-bog in Alsace, lying beside the skull of a bison, but this is supposed to have been brought there by early traders. A fossil species, resembling *P. Pinea*, was discovered by Saporta in a miocene deposit at Ardêche.

(A. H.)

### CULTIVATION

The tree is now widely cultivated in warm countries; and, according to Bunbury,[2] there were in his day extensive groves of it on the lower slope of Table Mountain and on the sandy flats to the east of Cape Town,[3] where it flourished as well as in Italy.

It was early introduced into England, being mentioned in Turner's *Names of Herbes*, published in 1548. It grows very slowly, and is somewhat tender, though trees may be seen in all the southern counties. According to Bunbury,[2] the trees at Hardwicke, in Suffolk, were all killed by the severe winter of 1860, those at Barton being injured and not doing well afterwards. In the woods at Addington Park all the trees of this species, which were forty to fifty years old, were dead or dying in 1890. Trees, however, at Kew and Richmond seem to have been unaffected by the severe frosts of exceptional years, and bear fruit in abundance.

The seeds[4] may be liberated by knocking the cone with a mallet, or by placing it in water hot enough to soften the resin which keeps the scales together. The scales will also come asunder if the cones are placed in a warm oven. Seeds should be soaked in water before sowing, and the seedlings should be kept in a cool frame for at least two years.

### REMARKABLE TREES

If I had not seen the remarkable plantation of this pine at Matchams, near Ringwood, I should have supposed that it was incapable of developing its normal character in any part of England, but here it seems so much at home that the conditions under which it grows are of interest. Hamilton Leigh, Esq., owner of this place, informs me that the trees were raised from seed sent by Lord Nelson from the Mediterranean about one hundred years ago, to the then owner of the estate. They grow close to the road and railway, at the foot of a great sandhill on the open barren heath, two or three miles south-west of Ringwood, in sand which is apparently never dried up in summer, owing to the percolation from the hill above;

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[1] Radde, *Pflanzenverb. Kaukasusländ.* 126 (1899).

[2] *Arboretum Notes*, 125 (1889).

[3] According to Hutchins, *Science in South Africa*, 395 (1905), there are some noble specimens still on the old farms; but about thirty years ago this species was attacked by a fungus (*Peronospora sp.*), and the tree is now likely to become extinct in Cape Colony.

[4] *Gard. Chron.* xxxvii. 240 (1905).

the trees being well sheltered from the south-west and drawn up by maritime pines which grow around them. They have the umbrella-shaped head of the true Roman pine, and are from 50 to 60 ft. high by 4 to 5 ft. in girth. They produce cones abundantly, which are attractive to squirrels, which eat the seed before it falls. By their bark, their cones, and their habit they are easily distinguished from the maritime pines.

Another place where the stone pine may be seen of some size, though in a climate evidently too moist to suit it, is at Killerton, where, on the top of the hill above the house, there are several old trees about 50 ft. by 7 to 8 ft., but they have an unsightly appearance owing to numerous half-dead branches. At the foot of this hill, on Taverner's farm there is another tree of the same kind, which is healthier.

At Saltram,[1] Devonshire, there are several trees, the largest of which is 60 ft. high and 8½ ft. in girth. The late Lord Morley sent me a photograph of this tree, which, however, is by no means typical in habit. At Mount Edgcumbe, Plymouth, there is another tree 54 ft. high, and 9½ ft. in girth at 3 ft. from the ground, with a spread of foliage 46 ft. in diameter. This tree has not borne cones, though two smaller trees at the same place produce fruit freely.

At Heron Court, in Dorsetshire, the seat of the Earl of Malmesbury, there are several stone pines, the largest of which is no less than 13 ft. in girth at 2½ ft., where it divides into large branches, but does not exceed 40 to 45 ft. high. There are two groups in the park of smaller size, all of which seemed to bear ripe seed in 1906.

At Melbury, Dorsetshire, there is a well-shaped tree about 50 ft. by 7 ft., showing bark rather like that of *P. Pinaster*, with broad flat plates, but duller and not so shining, and marked at intervals of about a foot, with irregular transverse rings, which seemed to show its annual growth.

At Kew the old tree near the Director's office measured,[2] in 1903, 31 ft. high and 7 ft. 7 in. in girth, with a spread of foliage 46 ft. in diameter.

A large tree[3] in the Red Lodge Nursery, Southampton, was blown down in 1903. It measured 61 ft. in height, and 8 ft. 7 in. in girth at 3 ft. from the ground, and was said to have been seventy-five years old.

At Eastnor Castle there is a group of stone pines which are curiously distorted by irregular concentric swellings round their trunks. They are only about 30 to 35 ft. high; but one, which forks very low, is no less than 8 ft. 10 in. in girth at 1½ ft. from the ground.

Sir Hugh Beevor reports a good tree at Chorley Wood Cedars, 50 ft. high by 9 ft. 11 in. in girth. At Burwood House, Surrey, Mr. R. Woodward reports a tree 50 ft. high and 8½ ft. in girth.

At Stackpole Court, Pembrokeshire, there is a tree about 30 ft. by 6½ ft. bearing cones which seem fertile, though here the climate seems too damp for this tree. There are two trees near the Orangery at Margam, about 40 ft. by 7½ ft., from which seedlings have been raised. At Penrhyn, North Wales, a tall slender tree was, in 1905, 53 ft. high by 4 ft. 10 in. in girth.

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[1] *Gard. Chron.* xxxiv. 413 (1903).

[2] Cf. *Kew Handlist of Coniferæ*, xxiii. (1903). This tree is figured in *Gard. Chron.* iv. 602, fig. 85 (1888).

[3] *Gard. Chron.* xxxiv. 285, figs. 121, 122 (1903).

A remarkable instance of the hardiness of this tree in Scotland was given by Captain Norman, R.N., at a meeting of the Berwickshire Naturalists' Club, in September 1905. He states that a group of six trees of this species are growing at the foot of a railway embankment close to the post road at Dunglass, East Lothian. They were identified at Kew, and bear cones annually, the largest being about 30 ft. high. These trees are said to have been planted by an Edinburgh firm soon after the railway was made in 1846. But though there are many parts of Scotland where the climate would seem to be much more suitable for this pine, we have seen none worth mentioning.

In Ireland, there is a fair-sized tree in the Trinity College Botanic Garden, Dublin; and at Hamwood, Co. Meath, a tree, planted in 1844, had attained, in 1904, 50 ft. in height and 6½ ft. in girth.

Mouillefert[1] says that the wood of *P. Pinea* is like that of *P. Pinaster*, but is less resinous, and the sapwood is abundant at a considerable age. At the Cape of Good Hope he thought that the lignification was quicker and more complete than in Europe. As to the comparative value of the wood of this pine and *P. Pinaster*, opinions differ in Portugal, but most people consider the stone pine the best.

(H. J. E.)

## PINUS DENSIFLORA, Japanese Red Pine

*Pinus densiflora*, Siebold et Zuccarini, *Fl. Jap.* ii. 22, t. 112 (1844); Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 503 (1881), and xxxv. 619 (1904); Mayr, *Abiet. jap. Reiches*, 72 (1890), and *Fremdländ. Wald- u. Parkbäume*, 343 (1906); Shirasawa, *Icon. For. Japon*, text 10, t. 1, ff. 1-14 (1899); Kent, Veitch's *Man. Coniferæ*, 326 (1900); Clinton-Baker, *Illust. Conif.* i. 18 (1909).

A tree attaining in Japan 120 ft. in height and 12 ft. in girth. Bark of branches and young trees, and of the upper half of the stem of old trees, reddish, and peeling off in thin scales, resembling that of *P. sylvestris*; towards the base of old trees rugged and dividing into small plates. Young branchlets glabrous, glaucous, with raised pulvini, separated by linear grooves. Buds cylindrical, sharp-pointed, dark-brown, ½ in. long, slightly resinous; scales free at their apices, but not reflexed.

Leaves in pairs, persistent about three years, spreading, 3 to 4 in. long, soft in texture, twisted, dull green, with eight to ten stomatic lines on each surface, ending in a short callous tip, serrulate; resin-canals marginal; basal sheath ⅜ in. long, often ending above in two long narrow filaments.

Cones subterminal, spreading, two or three together, sub-sessile, ovoid-conic, 2 to 2½ in. long, dull grey in colour; scales about 1 in. long and ⅝ in. wide, oblong, thin, with the concealed part pale brown above and reddish below, flat or slightly convex from side to side; apophysis rhomboidal, slightly raised, transversely ridged, upper margin irregularly sinuate, dull grey, with an elliptical dark brown umbo tipped with a minute mucro. Seed ¼ in. long, bright brown; wing narrow, pale brown, ½ to ¾ in. long.

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[1] *Essences Forestières*, 395 (1903).

This species,[1] which closely resembles *P. sylvestris* in the bark and buds, is readily distinguishable by the dull green longer leaves and the glaucous branchlets.

Numerous varieties of *P. densiflora* are in cultivation in Japan, no less than twenty-two being enumerated by Mayr. Some are dwarf, pendulous, globose, or otherwise peculiar in habit; whilst others have variously coloured foliage, golden, striped, variegated, etc. These are apparently unknown[2] in England. The hybrids between *P. densiflora* and *P. Thunbergii* are mentioned under the latter species.

*P. densiflora* appears to be confined to Japan, as the herbarium specimens from Korea and the Shantung hills[3] in China, supposed to belong to this species, are different in appearance, though undoubtedly closely allied. The representative of this species in central China is *P. Henryi*,[4] Masters, not yet introduced into cultivation. (A. H.)

This species, which is known by the Japanese as ***aka-matsu***, red pine, or ***me-matsu***, female pine, is the commonest conifer in Japan; but in most cases is planted, as it has been cultivated from ancient times, usually on poor dry soil, where other trees will not thrive. It is considered to be a native of the hilly mountainous district, generally between 500 and 3000 ft. elevation, scarcely ever ascending into the higher region, which is occupied by the silver firs and spruces, and being absent[5] from the sea-coast, where it is replaced by *P. Thunbergii.* According to Mayr it is rare in the subtropical forests at low elevations in the southern islands; but occurs as far north as south-western Yezo. In the wild state, I found the tree scattered here and there through the mixed forests, up to about 2000 ft., generally on dry ridges or sandy stony river banks. In the forest near Koyasan, it was larger than elsewhere, up to 12 ft. in girth; and one tree standing alone in a dense forest of *Cupressus obtusa* and *Sciadopitys* had a clear trunk of 60 ft. high or more, and measured about 100 ft. by 11 ft. 9 in. The best planted trees which I saw, were near the foot of the low pass between Shimonosuwa and Shiojiri in Shinshu, in private grounds by the roadside. These were over 100 ft. high and 8 or 9 ft. in girth, clean to 70 ft., and though not so straight in the stem as *P. sylvestris*, were very fine trees. More often, however, this pine has a crooked unsightly stem, and does not grow to any great size, being usually crowded, and cut when young; and it is only rarely that it has a chance of showing its full development, and becomes a fine tree; and then, with its reddish yellow bark on the upper half of the stem, and spreading crown, it reminds one much of *P. sylvestris*.

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[1] It is often known in cultivation, both in Europe and in the United States, as *P. Massoniana*, a species of southern China, not in cultivation.

[2] The varieties mentioned in *Kew Handlist Coniferæ*, 111 (1903), are not in cultivation in Kew Gardens.

[3] Mayr brought home from Korea living plants, which he considered to be this species. The Shantung tree, which grows on the hills near Chefoo, is imperfectly known, and has been mentioned by Masters in *Journ. Linn. Soc.* (*Bot.*) xxvi. 551 (1902), as *Pinus Massoniana*, Lambert, var. *planiceps*, Murray, MS. in Mus. Brit. It bears cones different in colour from those of *P. densiflora*; and is certainly quite distinct from *P. Massoniana*, a long-leaved species, inhabiting the plains of central China and the low hills of southern China. The Korean pine is *P. funebris*, Komarov, referred to on p. 1144, note 2.

[4] *Pinus Henryi*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxvi. 550 (1902) and xxxv. 618 (1904). This species, discovered by me in 1888, is a small tree, rarely exceeding 40 ft. in height, forming open woods, at 4000 to 6000 ft., in the mountains of Hupeh, Szechwan, and Shensi. The cones are subterminal, shortly-stalked, ovoid, 1½ in. long, shining reddish brown; scales oblong, ⅝ in. long, ⅜ in. wide; apophysis rhomboidal, slightly raised, with four radial ridges, and a depressed umbo, tipped by a minute prickle. Seeds light brown, with short, broad, dark brown wings. The foliage resembles that of *P. densiflora.*

[5] Mayr says that it is occasionally planted near the coast, and is sometimes found on the second range of hills near the coast, *P. Thunbergii* occupying the strand and the first range. The largest trees, up to 120 ft. in height, which he saw, were in the warm valleys of the central mountains of Hondo.

### Cultivation

This species was introduced[1] by Siebold in 1854, into the Botanic Garden at Leyden; but was not generally distributed until 1861, when seeds were sent home from Japan by J. Gould Veitch. It is, however, very rare in cultivation,[2] except in botanic gardens, as at Kew, where it is a handsome tree, ripening its cones perfectly, and displaying the characteristic bark. We have also seen specimens, of no great size, at Brocklesby, Lincolnshire; Bagshot, Surrey; High Canons, Herts; and Murthly, Perthshire.

At Grafrath, near Munich, it has proved perfectly hardy during the last twenty-five years; but is easily injured by snow. Young plants are liable to the attacks of the leaf-shedding disease.

According to Sargent,[3] it is hardy in New England, where it produces fertile cones in abundance, and is already beginning to assume its mature picturesque habit. So far as can be judged from an experience of twenty-five years, it appears to be the most promising of the two-leaved pines introduced into the eastern states from foreign countries.

The wood is usually coarse and knotty, but being the cheapest building timber in Japan, is largely used there. Mayr says it is very similar to that of *P. sylvestris*, and, as in that species, the amount of heartwood depends on the situation and age.

(H. J. E.)

## PINUS MONTANA, Mountain Pine

*Pinus montana*, Miller, *Gard. Dict.* Ed. 8, No. 5 (1768); Willkomm, *Forstliche Flora*, 209 (1887); Mathieu, *Flore Forestière*, 593 (1897); Kent, Veitch's *Man. Coniferæ*, 343 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 611 (1904); Schröter, *Pflanzenleben der Alpen*, 74 (1904); Kirchner and Schröter, *Lebensgesch. Blütenpfl. Mitteleuropas*, 202 (1906); Clinton-Baker, *Illust. Conif.* i. 34 (1909).

*Pinus mugus*,[4] Scopoli, *Fl. Carniol.* ii. 247 (1772).

*Pinus pumilio*, Haenke, *Beob. Reis. Riesengeb.* 68 (1791); Loudon, *Arb. et Frut. Brit.* iv. 2186 (1838).

*Pinus uncinata*, Ramond, in De Candolle, *Flor. Franç.* iii. 726 (1805); Cook, *Sketches in Spain*, ii. 230 (1834).

*Pinus humilis*, Link, in *Abhand. Berl. Akad.* 171 (1827); Kerner, *Nat. Hist. Pl.* Eng. Trans. i. 548, fig. 135 (1898).

*Pinus obliqua*, Sauter, in Reichenbach, *Flora Germ. Exc.* 159 (1831).

*Pinus uliginosa*, Neumann, *Schles. Ges.* 95 (1837).

Variable in habit, a tree or prostrate shrub, with greyish black scaly bark. Young branchlets brown, glabrous, with raised keeled pulvini. Buds ovoid or cylindrical, short-pointed, $\frac{1}{4}$ to $\frac{1}{2}$ in. long, covered with resin.

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[1] A plant, 18 in. high, in cultivation at Woburn in 1839, is named *Pinus japonica*, Forbes, in *Pin. Woburnense*, 33 (1840); but it is impossible to say from the description whether it was *P. densiflora* or *P. Thunbergii*.

[2] A thousand plants, imported from Japan, were planted in 1907 at Ampton Park, Suffolk; and about a hundred were living in 1910.

[3] *Garden and Forest*, x. 471 (1897).

[4] This name occurs in Scopoli as *mugus*, but *mughus* is adopted by all later writers. It is derived from the Italian name of the tree, *mugo*, used in south Tyrol.

Leaves in pairs,[1] persisting five to ten years, 1½ to 2½ in. long, rigid, curved, dark green,[2] ending in a short blunt cartilaginous point, serrulate, with stomatic lines on both surfaces; resin-canals marginal; basal sheath ½ to $\frac{6}{10}$ in. long.

Cones subterminal, solitary or two or three together, sessile or sub-sessile, 1 to 2 in. long, conical, ovoid or sub-globose; scales with shining dark brown apophyses, the ashy grey or light brown umbo being surrounded by a darker coloured ring. The variations in the size and shape of the cones and of the apophyses will be dealt with under the varieties. Seed similar to that of *P. sylvestris*, but slightly larger in the body and shorter in the wing. Seedling with two to eight, usually four to six cotyledons, about ⅝ in. long, entire in margin; primary needles shorter than the cotyledons, serrate, clothing the first year's shoot, and gradually replaced in the second year by the adult geminate leaves. The seedlings grow very slowly, attaining about an average height of an inch in the first year, and 2 to 3 ft. high in the tenth year. No well-developed tap-root is formed.

## VARIETIES

This species consists of numerous geographical races, which are difficult to define, as the variations in habit are not exactly coincident with the variations in the characters of the cones. In certain cases peculiarities in habit appear to be fixed and hereditary, whilst in other cases these are due to soil, climate, and exposure, and are not transmitted by seed. The cones are not constant in the various races; in rare cases they vary even on the same tree, and are often different in trees from the same locality. There is great difference of opinion amongst foresters and botanists as to the varieties, the number described being very great, but for practical purposes the following arrangement is convenient:—

1. Var. *uncinata*, Willkomm, *Forstliche Flora*, 171 (1875); Masters, in *Gard. Chron.* xxii. 208, fig. 42 (1884).

Usually a tall tree, with a single undivided stem, 60 to 80 ft. in height. Cones asymmetrical, very oblique at the base, ovoid-conical, 2 to 2½ in. long, directed downwards or pendulous, with the scales on the outer side strongly developed, their much raised and pyramidal apophyses ending in hook-like processes, which are directed towards the base of the cone. This variety, which has been called by Sir John Stirling Maxwell[3] the upright mountain pine, is the only form met with in Spain, in the eastern and central Pyrenees, and in the French Alps, and is of rare occurrence in Switzerland. It forms extensive woods in sub-alpine regions up to timber line.

With this variety must also be classed a shorter tree, 30 to 50 ft. high, which is met with in pure woods on some of the high-lying peat mosses in the Vosges, Jura, Switzerland, lower Austria, and Bohemia. Isolated trees of this form are also occasionally seen amongst the dwarf *P. montana* in the Alps of Switzerland and in the Tyrol; but it is not known to occur in the dwarf pine belt of the Silesian and Carpathian ranges. Dwarf pines with cones of this type are sometimes seen in exposed and barren spots in the western Alps, but these are supposed to be stunted by the nature of the situation where they grow.

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[1] Occasionally the needles are in threes, as in var. *mughus* in the Raxalp. Cf. Kronfield, in *Verhand. zool. bot. Ges. Wien*, xxxviii. 96 (1888).

[2] Koehne, *Deut. Dendrologie*, 39 (1893), states that in all forms of *P. montana*, the epidermal cells are twice as thick as in all other species, and have only linear cavities.

[3] In *Trans. Roy. Scot. Arb. Soc.* xxi. 10 (1908).

2. Var. *rotundata*, Willkomm, *Forstliche Flora*, 174 (1875).

Cones asymmetrical and oblique, as in the preceding variety, conical or ovoid, 1½ to 2 in. long, spreading or bent downwards, sessile, with the lower and occasionally the middle scales on the outer side ending in a short four-sided blunt pyramid, directed slightly downwards. Usually a tree, scarcely exceeding 30 ft. in height, with several stems arising close to the ground, due to the rapid development of the lateral branches which turn upwards, and becoming erect, grow as fast as the leader. This, which Sir John Stirling Maxwell calls the intermediate form[1] of the mountain pine, is found on sunny precipices, rocky slopes, and high peat-mosses, and is common in the whole of the Alps, except in France. The dwarf mountain pine in the Swiss Alps often bears cones of this type.

3. Var. *pumilio*, Willkomm, *Forstliche Flora*, 175 (1875).

A shrub, rarely over 6 ft. in height, prostrate in habit, with the branches tending to lie flat on the ground, only turning up at the ends. No definite leader is formed. Cones symmetrical, usually sub-sessile, ovoid or globose, smaller than in the preceding varieties, 1 to 1½ in. in diameter, spreading, tinged with violet before ripening; scales uniform in size; apophysis unequally divided with the umbo placed near the lower edge. This, one of the forms of the dwarf mountain pine, which comes true from seed, occurs in the Jura, Switzerland, Black Forest, Fichtel mountains, Bohemian and Bavarian forests, Riesen and Iser mountains, extending southward to Bosnia, Herzegovina, and Montenegro.

4. Var. *mughus*, Willkomm, *Forstliche Flora*, 177 (1875).

Similar to the last in habit, and in size, shape, and direction of the cones, and only distinguishable by the apophysis of the scale being very flattened with the umbo in the centre. This form is common in the eastern Alps and in the Balkan States, and is very rare in Switzerland.

Several hybrids between this species and *P. sylvestris* have been described, which are arranged by Ascherson and Graebner[2] as follows:—

(*a*) *P. sylvestris*, var. *engadinensis* × *P. montana*, var. *uncinata*. Found in the Upper Engadine, near Samaden, at 6000 ft. altitude.

(*b*) *P. sylvestris* × *P. montana*, var. *rotundata*. Found in peat-mosses on the boundary between Lower Austria and Bohemia and in southern Bohemia.

(*c*) *P. sylvestris* × *P. montana*, var. *pumilio*. Found in the southern Bohemian forest and in the Tyrol.

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[1] This form was introduced into Denmark in 1798 from Eisenach, in Thuringia, and has kept true from seed. Occasionally one of the stems takes the lead and suppresses the others, but in such cases the stem is always bent near the ground.

[2] *Syn. mitteleurop. Flora*, i. 229 (1896-98). These authors (*op. cit.* 232) state that a tree in the Botanic Garden at Vienna, supposed by Wettstein to be a hybrid between *P. Laricio*, var. *austriaca*, and *P. montana*, has been shown by Beck to be a pure Austrian pine.

## DISTRIBUTION

This species is widely spread in the mountainous regions of central and southern Europe,[1] extending from Spain in the west to Bukovina in the east, and from the Vosges and Lausitz (Saxony) in the north to the Abruzzi mountains in Italy and Perim Dagh in Macedonia, its most southerly stations.[2] The distribution of the mountain pine and of its varieties appears to depend mainly on the encroachment and competition of other species of conifers. In the west and south-west, where the spruce, its greatest rival, is rare or absent, it descends to comparatively low levels, and is a fine tree forming extensive forests; whereas in the central, eastern, and south-eastern parts of its range it has to contend with the spruce or larch, and occasionally with *P. Cembra*, and driven to high altitudes, it has become a mere shrub. In many parts it also forms woods on peat-mosses at moderate elevations in the mountains, where it grows better than either *P. sylvestris* or the spruce.

In Spain it occurs from the Sierra de Cuença through Aragon and Catalonia to the central[3] and eastern Pyrenees, forming vast forests, which were first described by Capt. Cook (Widdrington).[4] In the Pyrenees the spruce is a rare tree, found sparsely mixed with silver fir, and the larch is totally absent. In consequence the mountain pine reigns alone in this range at high elevations, occurring between 5000 and 8000 ft., and attaining its maximum development, trees 100 ft. in height and 9 ft. in girth having been measured by the French forest officers. Sir J. Stirling-Maxwell,[5] who visited this region in winter, says that the finest forests were then inaccessible, but he obtained excellent photographs of woods of this species at lower levels, where trees about seventy years old averaged 55 ft. in height and 3 ft. in girth. He notes the straight cylindrical stems of the Pyrenean variety, with grey coloured bark, and a narrow crown of foliage, and compares the tree in all its stages of growth to the Corsican pine. On account of its narrow pyramidal habit and tough elastic wood it scarcely suffers from heavy snowfall, and is in marked contrast in this respect to *P. sylvestris*, which grows from lower levels up to where the mountain pine begins. Up to forty years old it is relatively fast in growth, being a slender and regular tree, but after this age there is a marked diminution in height growth, accompanied by increase in thickness of the stem and by a rounder crown. Still at seventy years it preserves its narrow pyramidal habit, the stout cylindrical stem carrying branches which are remarkably short and light. Its root system is shallower than that of *P. sylvestris*, which can only keep pace with it in growth in the Pyrenees on the better soils. The mountain pine is the least exacting of trees, whether as regards soil, aspect, or climate.

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[1] C. Reid, in *Journ. Linn. Soc.* (*Bot.*) xxxviii. 220 (1908), doubts the occurrence of this species in British pre-glacial deposits, where it had been identified by Heer and Saporta.

[2] Judging from the description, *P. Kochiana*, Klotsch, and *P. armena*, Koch, both in *Linnæa*, xxii. 297 (1849) are incorrectly referred to *P. montana* by Medwejew in *Bäume u. Sträuche Kaukasus*, i. 14 (1907). This peculiar pine occurring in the Caucasus around Ardahan, near Kars, and in Daghestan, has hooked cone-scales, and is *P. sylvestris*, var. *hamata*. Steven, in *Bull. Soc. Nat. Mosc.* xi. 52 (1838).

[3] The forests in the central part of the Pyrenees (departments of Ariège and Haute-Garonne) are nearly all destroyed; those in the eastern part (Pyrénées Orientales and Hautes-Pyrénées) are still of considerable extent.—Mathieu, *op. cit.* 596.

[4] Cf. Loudon, *op. cit.* 2188.

[5] In *Trans. Roy. Scot. Arb. Soc.* xxi. 10-15, figs. 1-9 (1908).

In France the tall upright variety also occurs on Mt. Ventoux and throughout the Alps of Provence, Dauphiné, and Savoy, where it grows at high elevations from 4800 to 8000 ft., on dry, poor, and rocky soils. At Briançon it does not attain so large a size as in the Pyrenees, and, according to Sir J. Stirling-Maxwell, at forty years scarcely attains 40 ft. in height, averaging 20½ in. in girth, while Scots pine alongside it is about the same height, but 27 in. in girth. The finest trees of this variety in the French Alps occur in the wild forest of Villarodin-Bourget, near Modane, which I visited in 1903. Here it forms a dense wood on the sides of a dry ravine between 5000 and 7000 ft. elevation, mixing at the lower level with *P. sylvestris*, the trees being about 60 to 70 ft. in height and 1 to 1½ ft. in diameter, and remarkable for their narrow pyramidal habit and their number on the ground, casting a dense shade. Higher up on the side of the ravine there are many isolated trees, very old, and of great size, up to 80 ft. in height and 9 ft. in girth. The stems of some of the smaller trees are marked with ring-like swellings, one above another, and full of resin, which are caused by the larva of a beetle. Seedlings are common here, and Elwes, who visited this locality in 1907, brought home some alive, which are now growing at Colesborne.

In the Jura, near Pontarlier, on peat-mosses, the shorter upright form, characteristic of this situation, occurs in small open woods. Here the trees rarely exceed 40 ft. in height, and are much more widely branched than those at Modane.

The upright form is also found sparingly in several localities in the Swiss Alps, Swabia, Oberpfalz, Silesia, Bohemia, and the Erz mountains. An extensive forest, with an area of 6000 acres, occurs on dolomite in the Lower Engadine, near Zernetz, at 5800 to 7000 ft. elevation, extending through the Ofen Pass to the Münster valley. Here the trees, many of which are of the intermediate form, gradually mix at the lower edge of the forest, with spruce, larch, and *P. sylvestris*. This forest is illustrated in *Les Arbres de la Suisse*, pl. xvii., which shows trees like those of Modane, but smaller, the largest depicted being 47 ft. high and 3 ft. 4 in. in girth. Another is recorded as 50 ft. by 5 ft. 3 in.

The intermediate form is common, mixed with the upright form, in all the localities of the latter, except in the Pyrenees and French Alps, and is usually met with on sunny precipices, rocky slopes, and high-lying peat-mosses.

The dwarf form (vars. *pumilio* and *mughus*) is widely spread throughout the Swiss, Italian, Austrian, and Bavarian Alps, ranging in the latter from 2000 to 4800 ft. elevation; and it extends through the Black, Bohemian, and Bavarian forests; in the Fichtel, Reise, Glatzer, and Iser mountains, occurring in the latter from 2000 to 2700 ft. altitude; in the Carpathians between 4200 and 6500 ft.; in the Bihar mountains of Hungary; in the mountainous regions of Carinthia, Carniola, Dalmatia, Bosnia, Herzegovina, Roumania,[1] Bulgaria, reaching its southernmost point in Perim Dagh in Macedonia. In Italy it is only known, outside of the Alps, on Mount Amaro in the Majella group of the central Apennines, where

[1] Golesco, in *Bull. Soc. Dend. France*, 1907, p. 176, gives a good description of the dwarf pine in the mountains of the Muscel district in Roumania, which comprise the highest summits of the Transylvanian ranges.

it[1] occurs between 6000 and 8700 ft., the latter being the highest elevation known for the species.

The dwarf mountain pine,[2] known as the *Legföhre*, is one of the most characteristic shrubs of the Alps and Carpathians, in some places covering large areas with a dense, almost impenetrable thicket, composed of decumbent stems, whose branches are so interlaced that though one may pass through it with difficulty in a lateral direction, and slide downwards over it on a steep hill-side, yet to ascend it is practically impossible. These thickets are well described by Kerner,[3] who says that the stems, even when of great thickness, assume a horizontal position, with their growing ends always directed on mountain slopes towards the valley. The branches are remarkably elastic, and in winter are pressed downwards upon the soil by the heavy snow-fall; and in summer rise up again, often plastered with earth and small stones, and take a curved ascending position.

*P. montana* is remarkable for its different behaviour in regard to the chemical elements in the soil in different parts of its area. In the French Alps the extensive woods of this species cease to grow when the Jurassic chalk comes to the surface. Near the Aiguilles the tree is absent from slate formations, but immediately appears wherever the soil is composed of lime or chalk. At Grächen in Nicolai valley it grows on slate, and at Davos on serpentine. In the Engadine it occurs mainly on dolomite, but is not entirely absent from the gneiss formation. In the Carpathians it is indifferent to the nature of the soil. Christ says that in the Swiss Alps generally it is decidedly a lover of lime, often growing on rubbly limestone rocks, and alternating markedly with *Alnus viridis*, which clothes the declivities of the primitive non-calcareous rocks.[4]

In the Pyrenees the tree is found to be especially valuable for windy plateaux. It thrives in soils too poor for any other trees to grow, and succeeds better[5] on peat than *P. sylvestris*. It is extremely hardy, easy to raise from seed, and presents no difficulty in transplanting. It is used now throughout the French Alps for planting at high altitudes and in all difficult situations. It is comparatively free from the attacks of fungi and insects. (A. H.)

## CULTIVATION

This species was first cultivated in England in 1779, at Orford Hall, near Warrington, Lancashire, where the shrub of var. *pumilio* originally introduced was still living, though in a shattered condition, in Loudon's time.

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[1] Described as *P. majellensis*, Schouw, in *Ann. Sc. Nat.* iii. 233 (1845). Referred to *P. Laricio* by Parlatore; but as Masters points out, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 613 (1904), the resin-canals are marginal, and not median as in *P. Laricio.*

[2] At Innsbruck, according to Beissner, in *Mitt. d. dendr. Ges.*, 1905, p. 69, the tall, intermediate, and dwarf pines are distinguished by different names, Spirke, Latsche, and Zunder or Knieholz; but these names are not current everywhere with the same signification.

[3] *Nat. Hist. Plants*, Eng. trans., i. 548, fig. 135 (1898).

[4] Cf. Schimper, *Plant Geography*, 100, 104 (1903).

[5] In the high peat-moors of the Hertogenwald, in Belgium, at 2000 ft. altitude, a few plants of the intermediate variety were doing better on deep peat than any other tree when I saw these plantations in 1909.

The Pyrenean form was apparently introduced by Captain Cook, as young plants were raised in the garden of the Horticultural Society from seed procured by him. Apparently this variety has been entirely neglected since, and we are scarcely in a position to judge concerning its capabilities as a forest tree in mountainous districts and on peat-mosses in this country; but recently some experimental planting has been done by Sir John Stirling Maxwell[1] at Corrour, Inverness-shire, with seeds obtained from the government seed-establishment at Mont Louis, in the Pyrénées Orientales. The finest examples of this form that we have seen is a tree at Essendon Place, Hertford, which measured, in 1907, 51 ft. in height, with a stem clear of branches to 30 ft., and 5 ft. 5 in. in girth. A good specimen in the Cambridge Botanic Garden measures 41 ft. by 3 ft. 5 in. At Sir H. Farquhar's seat, Gilmanscroft, Ayr, there is a tree of this variety. At Glasnevin a slender tree measures 35 ft. high by 2½ ft. in girth.

When Henry was at Annecy in 1904 the late Mr. Guinier, Inspecteur des Forêts, showed him a plantation of *P. montana*, twelve years old, raised from Pyrenean seed. He considered that this race is quite distinct and much finer than the race in the French Alps. Its growth is only slightly less vigorous than that of *P. sylvestris*, over which it has certain advantages, as it is the sole species in France available for planting peat-mosses, and, moreover, thrives on arid soils, where *P. sylvestris* grows very slowly. It has a dense cover, but always lets a little sun fall on the ground, even in the thick forests of the Pyrenees. The two races, that of the French Alps and that of the Pyrenees, planted in the Forêt du Crêt du Maure, near Annecy, retain their characteristic differences.

The intermediate form seems to be the one most general in cultivation, not only in this country, but also in Denmark, where it has been extensively used for planting the dunes and barren tracts in Jutland. It was introduced into Denmark from Eisenach in Thuringia in 1786, and has come true from seed. It attains on poor soil about 20 ft. in thirty or forty years, and then ceases to grow; and can scarcely be looked upon as of any economic value, though the improvement of the soil may prepare the way for other species. In Denmark[2] it is usually planted on the dunes pure at first, and afterwards the common spruce is introduced, which is a more valuable species, but one impossible to start by itself on poor soil covered with heather. Müller, who is the greatest authority on this species of pine, introduced the upright variety[3] of the French Alps in 1886; but it is said to be more liable to the attacks of fungi. It is remarkable in this, as in many other cases of introduction of a species, that the seed from the best form (from the Pyrenees) should not have been selected.

In England the best specimen we have seen of the intermediate variety is a tree at The Wilderness, White Knights, near Reading, which consists of six stems, arising from a very short butt 6 ft. in girth, and rising to 60 ft. in height. There are also four trees at Bayfordbury, which are about 40 ft. high, each with three to five stems from near the base, where they curve and turn upwards. Another at Arley was 32 ft. by 3 ft. 2 in. in 1904.

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[1] *Trans. Roy. Scot. Arb. Soc.* xx. 7 (1907). The seed of the Pyrenean variety, which can be obtained through the British Embassy at Paris, has been regularly supplied to the Norwegian Government for the last three years.

[2] Cf. *Quarterly Journ. Forestry*, iii. 74 (1909), where a full account of the heath plantations in Denmark is given by Mr. A. C. Forbes.

[3] Known as the *Pin de Briançonnais*, or in seed catalogues as *P. montana gallica.*

My father some fifty years ago planted some thousands of this tree at Colesborne in ignorance of their habit, and though they will live on the poorest and thinnest oolite, yet not one of the survivors would repay the trouble of cutting down, except for burning in closed stoves or for charcoal; for which it is said to be very well adapted. Here and there a tree drawn up among others has grown to be 20 to 30 ft. high, but the majority form straggling bushes, which produce cones abundantly, but have no beauty; and I cannot honestly recommend any one to plant this species at present.

Of the shrubby form, var. *pumilio*, the most remarkable specimen is probably one at Burwood House, Surrey, of which Col. Thynne has taken a photograph. It measures about 11 ft. high, and is 156 ft. in circumference around the prostrate ends of the branches. At Belton Park, Grantham, a large shrub of this kind is about 15 ft. high, and spreads on all sides for about 30 ft. There is a large spreading bush, about 30 ft. high and 45 paces round, at Spetchley Park, near Worcester, the seat of R. V. Berkley, Esq. (H. J. E.)

## PINUS CONTORTA

*Pinus contorta*, Loudon, *Arb. et Frut. Brit.* iv. 2292 (1838); Sargent, *Silva N. Amer.* xi. 89, t. 567 (1897), and *Trees N. Amer.* 26 (1905); Kent, Veitch's *Man. Coniferæ*, 323 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 630 (1904); Clinton-Baker, *Illust. Conif.* i. 16 (1909); Shaw, *Pines of Mexico*, 29 (1909).

*Pinus inops*, Bongard, in *Mem. Phys. Math.* pt. ii. *Acad. Sc. St. Petersb.* ii. 163 (1831) (not Solander).

*Pinus Boursieri*, Carrière, in *Rev. Hort.* 1854, p. 225.

*Pinus Mackintoshiana*, Lawson, *Cat.* (1855).

*Pinus Bolanderi*, Parlatore, in DC. *Prod.* xvi. 2, p. 379 (1868).

This species is very variable in habit and size, constituting a series of geographical races, which require further study in the field. It may be described as follows:—A tree or shrub, with either thin or thick bark. Young branches glabrous, with slightly raised keeled pulvini. Buds cylindrical, acute at the apex, about ½ in. long, encrusted with white resin. Leaves in pairs, persistent three to eight years, curved, twisted, 1 to 3 in. long, serrulate, ending in a callous point, with numerous stomatic lines on both surfaces; resin-canals median; basal sheath ¼ in. long.

Cones sub-terminal, on short stout scaly stalks, in pairs or clustered, opening when ripe or remaining closed[1] for many years, ovoid or conical, ¾ to 2½ in. long, unequal and oblique at the base, spreading or deflexed. Scales thin, variable in size, up to $\frac{3}{4}$ in. long and $\frac{3}{8}$ in. wide; those on the outer side near the base with elevated pyramidate apophyses; the others with a rhomboidal transversely ridged apophysis and an elevated umbo, which is armed with a minute recurved, often deciduous prickle. Seed $\frac{1}{8}$ to $\frac{1}{6}$ in., triangular, blackish, furrowed; wing variable in length; cotyledons,[1] three to five, usually four.

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[1] Sargent, in *Bot. Gazette*, v. 54 (1880), says that he sowed in 1879, seed from closed cones collected by Engelmann in Colorado in 1874. Seeds of cones thirteen and ten years old did not germinate, but the seeds of some cones of nine, eight, and seven years old did germinate. This shows according to Engelmann, *Bot. Gazette*, v. 62 (1880), that the object of the tree keeping the cones closed, is to preserve the vitality of the seeds for a number of years beyond their maturity.

This species is only liable to be confused with *P. montana*, from which it is readily distinguishable by the short basal sheaths of the leaves and the median resin-canals. Two main varieties, considered by many botanists and foresters to be distinct species, are recognizable :—

1. SHORE PINE, typical *P. contorta*.—Usually a small tree, 10 to 30 ft. high, though attaining 60 to 70 ft. when sheltered and on good soil. Bark $\frac{3}{4}$ to 1 in. thick, deeply divided into oblong scaly plates. Leaves dark green, 1 to $1\frac{1}{2}$ in. long, slender, $\frac{1}{24}$ to $\frac{1}{16}$ in. wide. Cones ovoid, very variable in size, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, some opening their scales when ripe, others remaining closed on the tree for many years.

Typical *P. contorta* occurs on the Pacific Coast from Alaska[2] to Mendocino County,[3] in California, usually inhabiting sand-dunes or barrens or growing on ocean bluffs. In western Vancouver island it is a low twisted shrub when growing along the edges of the forest next the ocean; but on peat-mosses[4] in the forest it is a small irregular flat-topped slow-growing tree. It begins to flower and fruit when only a few feet high; and the ripe cones remain unopened on the older branches and on the stem of the tree. On the high mountains opposite Vancouver I saw this tree growing in the forest in small glades on rocky poor soil, at 500 to 750 ft. altitude, not far from the sea; and it did not exceed 20 ft. in height, producing small ovoid cones, $\frac{3}{4}$ in. in diameter, most of which opened as soon as ripe.

On the seashore close to Crescent city in northern California, this species occurs on the ocean bluffs and on the barren gravelly flat to about a mile inland, and is very variable in size, in exposed situations dwindling to a picturesque shrub, but where sheltered attaining a considerable size, one tree which I measured being 65 ft. high and 7 ft. in girth. This tree had dark grey thin unfurrowed bark, covered with small scales, and resembling exactly that of var. *Murrayana*. A slightly smaller tree, beside it, which I took in the same photograph, had the thick coarsely fissured bark of typical *P. contorta*. Most of the cones were persistent.

2. LODGE-POLE PINE.

Var. *Murrayana*, Engelmann, in Brewer and Watson, *Bot. California*, ii. 126

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[1] The seedling is described by Hill and de Fraine, in *Ann. Bot.* xx. 472 (1906) and xxiii. 203 (1909).

[2] Gorman, in *Pittonia*, iii. 69 (1896), says it is confined to lake borders and margins of sphagnum marshes in Alaska, where it is comparatively rare and little used, except for fuel. The inner bark is eaten by the natives. He adds that he saw one specimen on Square Island 100 ft. in height and 18 in. in diameter.

[3] Jepson, in *Flora W. Mid. California*, 23 (1901), says it is frequent on the Mendocino coast, northward of Pt. Arena, as a low tree, 5 to 20 ft. in height.

[4] Cf. Butters, in *Postelsia*, 157, plate xii. (1906), where a picture is given of this tree growing in a sphagnum swamp.

(1880); Sargent, *Silva N. Amer.* xi. 90, t. 568 (1897), and *Trees N. Amer.* 27 (1905); Kent, Veitch's *Man. Coniferæ*, 324 (1900).

*Pinus contorta*, Loudon, var. *latifolia*, Watson, in King's *Rep. U.S. Geol. Survey 40th Parallel*, v. 330 (1871).

*Pinus Murrayana*,[1] Balfour, *Rep. Oregon Expedition*, 2, t. 3 (1853); Mayr, *Fremdländ. Wald- u. Parkbäume*, 358 (1906).

*Pinus inops*, Bentham, *Fl. Hartweg*, 337 (1857) (not Solander).

*Pinus contorta*, Newberry, in *Pacific R. R. Rep.* vi. pt. iii. 34, 90 (1857) (not Loudon).

*Pinus Tamrac*, A. Murray, in *Gard. Chron.*, 1869, p. 191.

*Pinus tenuis*, Lemmon, in *Erythea*, vi. 77 (1898).

A tall tree, varying from 70 to 200 ft. in height; bark rarely more than ¼ in. thick, covered with small loosely appressed scales. Leaves 1½ to 3 in. long, $\frac{1}{16}$ to ⅛ in. broad, yellowish green. Cones very variable: in specimens which I gathered in the Siskiyou mountains, Oregon, from small trees occupying burnt areas, an inch in length, very oblique, deflexed, and remaining closed for an indefinite period; in specimens collected in Montana, slightly larger, but many opening when ripe; in the Sierra Nevada, usually larger, up to 2 in. in length, and apparently always opening when ripe, and falling from the tree in the following season. Probably three distinct forms of this variety can be distinguished:—

1. Rocky Mountain form, occurring from Alaska to Montana. A slender tree, rarely over a foot in diameter, and 100 ft. in height in its best development. Cones late in opening. The form in Colorado, distinguished as *P. Murrayana*, var. *Sargenti*, Mayr, in *Waldungen Nord-Amer.* 350 (1890), seems to be similar to the tree in Montana, and like it has long leaves (3 in. in length).

2. Sierra Nevada form. A large stout tree, attaining 150 ft. in height and 9 ft. in girth. Cones usually opening when ripe.

3. Intermediate forms between var. *Murrayana* and typical *P. contorta* occur as small trees, 40 ft. or less in height, in the Cascades and the Siskiyou mountains; and have slender foliage and closed cones.

The lodge-pole pine has an exceedingly wide distribution in western North America, extending from the hills in the valley of the Yukon river, Alaska, through the interior plateau of British Columbia, where it occurs at 2000 to 4000 ft. It crosses the Rocky Mountains in the valley of the Peace river, lat. 56°, its eastern boundary in Alberta being the meridian of 114° longitude, west of Edmonton and Calgary. A small isolated forest[2] of this pine occurs at 3000 ft. altitude, south-east of Medicine Hat, in the Cypress Hills, which take their name from this tree, as both it and *P. Banksiana* were called *cyprès* by the early French voyageurs.

In the United States, it forms extensive forests on both sides of the Rocky

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[1] The type specimen of *P. Murrayana* is preserved in the herbarium of the Royal Botanic Garden at Edinburgh, and is labelled in Jeffrey's handwriting as follows:—"*Pinus* sp. No. 740. Found in the Siskiyou mountains in lat. 43° 30′, elevation 7500 ft., growing on moist, deep, loamy soil, Oct. 21st. This, all the cones I could procure. Tree 40 ft. high, of a conical form." Lat. 43° 30′, far to the northward of the Siskiyou mountains, is evidently a mistake for lat. 41° 30′, as we know from Jeffrey's type specimen of *P. Jeffreyi*, which was collected three days later (Oct. 24, 1852) in lat. 41° 30′ in the Shasta valley. Another specimen at Edinburgh, of which there is a duplicate at Kew, is labelled:—"740. *Pinus* sp. Same as No. 740 of 1852 collection. Summit of Sierra Nevada mountains near Walker's Pass, Sept. 20, 1853." This specimen did not reach Edinburgh until after the publication of the species by Balfour.

[2] Macoun, in *Proc. Roy. Soc. Canada*, xii. 4, pp. 13, 15 (1894).

Mountains in Montana; and extends southward, in the Yellowstone Park, at 7000 to 8000 ft., through the mountains of Wyoming and Colorado, to New Mexico and Arizona. Westwards it is common on the ranges of eastern Washington, Idaho, and Oregon, extending through the Siskiyou mountains into California, where it attains its largest size in alpine forests on the Sierra Nevada, at 8000 to 9500 ft.; and in the southern part of the state, forms the timber line on the highest peaks of the San Bernardino and San Jacinto mountains. It is also found[1] on the San Pedro Martir mountain in Lower California.

In Montana, where I saw it in the Lewis and Clark Reserve, it is essentially the tree which occupies burnt areas, its seedlings appearing in profusion in the mixed Douglas and larch forests, when these are destroyed by fire. In consequence, it is usually seen in dense even stands of tall slender trees, which attain about 100 ft. in height and a foot in diameter at 150 years old. Klers Koch,[2] forester in the Gallatin Reserve, reports on its facility of reproduction, as it bears cones early in life, even at 10 to 15 years old when crowded, and says that fire after fire may sweep over a district, and after each fire a new growth of pine springs up, denser than the preceding one. In a sample plot 10 ft. square, taken in a burnt area, 95 pine seedlings had sprung up. In 1885, a fire completely swept the whole length, 20 miles, of the Gallatin cañon, and there is at present a dense growth of young pines covering the mountain sides. He says that the root system is superficial, and the tree is easily blown down by the wind, as I witnessed myself near Flathead lake, when the tall slender trees came down in a sudden storm like ninepins. The tree appears to grow on most soils, though Koch has noticed that it avoids limestone, and it occurs at a great range of altitude, being met with, according to Leiberg,[2] in the Bitter-root Reserve in Idaho, at 2000 to 9000 ft. In Gallatin county, above 7000 ft. it mixes with spruce and *Abies lasiocarpa*, being replaced at 8500 ft. by *P. albicaulis.*

In Idaho, though it usually occurs as dense stands on fire-swept areas, it also grows in considerable quantity in swampy tracts, north-east of Grace Peak, and attains a much greater size, up to 200 ft. in height, with trunks 16 in. in diameter, and clear of branches to 140 ft. and showing 275 years' growth. Low branching trees, resembling *P. contorta* in habit, are met with in northern Idaho at elevations below 3000 ft. The tree demands light in order to grow well, but bears a considerable amount of shade, though in that case making little growth, a tree 43 years old that had been suppressed, measuring only 6½ ft. high and 1½ in. in diameter. In Colorado, it appears to be a smaller tree than farther north, averaging 75 ft. in height and 8 to 14 in. in diameter.

Mr. F. R. S. Balfour has kindly supplied us with the following account of the fine form of var. *Murrayana*, which grows in the Sierra Nevada of California:—

"On the main ridge between the valleys of the Kaweah and King's rivers, there are large quantities of fine tall trees 100 to 125 ft. high, and earning for *contorta* the more dignified name of *Murrayana.* I camped for two nights in a grove of these trees where there were many 12 ft. in circumference and over 100 ft.

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[1] Shaw, *Pines of Mexico*, 29 (1909).

[2] From notes supplied by the U.S. Forestry Department, Washington.

high. The whole character of the tree differs utterly from the little lodge-pole pine usually growing elsewhere. These had bark of a warm pinky brown in small flat flakes pressing closely to the stem. They were for the most part over 200 years old, and indeed I counted over 300 rings in one tree not 2 ft. in diameter. The altitude was about 8500 to 9500 ft., and therefore covered with deep snow for about eight months in the year. Many dead trees stood among the living ones, white and bleached, but showing uniformly that the fibre of the timber grows with a twist. This twist in the wood saves it from the lumbermen. In their opinion it would be a first-rate timber of great hardness and lasting quality, were it not for this peculiarity. The older trees have fine open crowns with perfectly straight stems, and no large branches. Where the bark has been bruised off from any cause, the sap-wood shows bright saffron yellow till healed over. I never saw this variety of *Pinus contorta* lower down than 8500 ft., and it grew immediately above the *Abies magnifica* belt."

### HISTORY AND CULTIVATION

*P. contorta* was discovered in 1825 by Douglas, near Cape Disappointment in Washington, at the mouth of the Columbia river; but it does not appear to have been introduced until 1855, when it appeared in Lawson's Catalogue under the name *P. Macintoshiana*.[1]

Var. *Murrayana* was discovered in 1852 by Jeffrey, who sent specimens and seed, which reached Edinburgh in the following year. A further supply, which he collected on 20th September 1853, on the summit of the Sierra Nevada in California, near Walker's Pass, arrived in 1854.

The characters, which separate *P. contorta* and its variety *Murrayana* in the wild state, are not entirely preserved under cultivation. Trees labelled *P. contorta* in Kew Gardens, show vigorous branchlets with broad leaves; and owing to the occurrence of spring shoots, the cones are often pseudo-lateral in position. These trees have furrowed bark, as in their native home, and are widely branched, with peculiarly curved branchlets.[2] Trees of var. *Murrayana* in cultivation show a narrow pyramidal habit, with fine scaly bark; but their leaves are scarcely as broad as in wild specimens. Coming from the interior of the continent, they are not so vigorous in growth as the typical form from the Pacific coast. At the nursery of the Arboretum at Tervueren in Belgium, there are batches of seedlings of both forms, those of typical *contorta* having vigorous shoots with short needles, those of var. *Murrayana* with shorter shoots and longer bright green needles.

(A. H.)

The finest specimens of var. *Murrayana* which we have seen, are growing in the pinetum at Westonbirt, where there are two trees narrowly pyramidal in habit and with scaly bark, 59 ft. by 4 ft. 7 in., and 50 ft. by 3 ft. 3 in. Both were bearing cones in 1909. In addition, there are about twenty trees, smaller in size, about 30 ft. high and twenty-five years old. At Westonbirt this species becomes yellow in foliage, and does not thrive on limestone. It is said to be a bad rooter, and easily blown down by the wind. At Merton Hall, Norfolk, there is a tree 47 ft. by 4 ft. 5 in. (Plate 292).

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[1] Cf. Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 647 (1904). Fowler, in *Gard. Chron.*, 1872, p. 1070, states that it was often grown then under this name; but he is in error in stating that *P. contorta* was introduced by Douglas, as there is no record of this in Loudon, who first described the species.

[2] This is well shown in *Gard. Chron.* xix. 45, fig. 5 (1883), where a branch of typical *contorta* from Barron's nursery at Borrowash is figured. Engelmann, in *Gard. Chron.* xix. 351, erroneously supposes, on account of the broad needles, that the figure represents var. *Murrayana*.

At Bayfordbury, a tree with a straight stem and scaly bark, measured in 1905, 49 ft. high by 4 ft. 9 in. in girth. There are two specimens at Pampisford, Cambridge, drawn up in a wood, which measure about 40 ft. in height and 2 ft. in girth. At Highclere, where there are six trees, one growing in a plantation measures 50 ft. by 3 ft. 5 in., and one in the open is 40 ft. by 5 ft. There are also smaller trees at Nuneham Park, Oxford, and at Ochtertyre, Perthshire. The best we know in Scotland is at Castle Menzies, which I found in 1908 to be 51 ft. by 5 ft. 10 in. A tree of typical *contorta*, planted in 1886 at Grayswood, Haslemere, as *P. Bolanderi*, measured, in 1906, 28 ft. by 3 ft. 1 in.

Mayr considers var. *Murrayana* to be close to *P. Banksiana*, both from a botanical and a biological point of view, and recommends it for planting in cold situations on high-lying moors. When planted closely, it cleans its stem readily, and at Grafrath, near Munich, where it has been planted in a cold peaty soil, it has endured a minimum temperature of – 22° Fahr. But at Nürnberg, where 65,000 young trees were planted in a moist situation, they are reported to be tender to frost. At Grafrath this species grows even faster than *P. Banksiana*.

The lodge-pole pine, introduced[1] from Colorado into the Arnold Aboretum about 1877, has proved hardy in New England and produced cones; but it suffers from fungi and gives no promise of permanent success.

### TIMBER[2]

The wood of the lodge-pole pine is coarse in grain, full of knots; and warps and cracks badly. It is soft, white, light, and not very strong, with little sapwood. It has been little used hitherto, except for mining purposes, the Amalgamated Copper Company having purchased, for example, fifty million feet (board measure) in 1906 from the Hellgate Reserve in Montana. It is coming into use, however, of late, for railway sleepers, for which it is suitable when creosoted, and the Burlington and Missouri Railway Company has begun to make extensive experiments in the preservation of this timber. It is in considerable use for fencing, but cannot be used for posts or telegraph poles, as it rots quickly when placed in contact with the ground. (H. J. E.)

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[1] Sargent in *Garden and Forest*, x. 471 (1897).

[2] Notes taken by forest officers, in the U.S. Bureau of Forestry, Washington, are here summarised.

## PINUS RESINOSA, Red Pine

*Pinus resinosa*, Solander, in Aiton, *Hort. Kew.* iii. 367 (1789); Loudon, *Arb. et Frut. Brit.* iv. 2210 (1838); Sargent, *Silva N. Amer.* xi. 67, tt. 555, 556 (1897), and *Trees N. Amer.* 25 (1905); Kent, Veitch's *Man. Coniferæ*, 372 (1900); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxv. 614 (1904); Mayr, *Waldungen Nord-Amer.* 211-214 (1890), and *Fremdländ. Wald- u. Parkbäume*, 346 (1906); Clinton-Baker, *Illust. Conif.* i. 48 (1909).

*Pinus sylvestris*, Linnæus, var. *norvegica*, Castiglioni, *Viag. Negli Stati Uniti*, ii. 313 (1790).

*Pinus rubra*, Michaux f., *Hist. Arb. Amer.* i. 45, t. 1 (1810) (not Miller).

A tree, usually attaining in America a height of 70 to 90 ft., and a girth of 6 to 9 ft.; occasionally, under most favourable conditions, reaching 150 ft. high and 15 ft. in girth. Bark about an inch thick, divided by shallow fissures into broad flat scaly ridges. Young branchlets orange-brown, glabrous, with raised rounded imbricated pulvini, which persist as rough protuberances on the older branchlets, from which the leaves have fallen. Buds elongated, conical, pale-brown, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, coated partly with white resin, with a few of the appressed scales free at their acuminate tips.

Leaves in pairs, deciduous in the fourth year, densely crowded on the branchlets, forming cup-like tufts at their apices, more or less spreading below, 5 to 6 in. long, dark green, shining, soft and flexible, sharp-pointed, serrulate, obscurely stomatic on the inner and outer surfaces; resin-canals marginal; basal sheath $\frac{7}{8}$ in. long.

Cones[1] sub-terminal, solitary or in pairs, sub-sessile, spreading, ovoid-conic, about 2 in. long, light brown, shining; scales $\frac{7}{8}$ in. long, $\frac{1}{2}$ in. wide; apophysis thickened, rhomboidal, with a transverse ridge, and a central depression, in which lies the rounded shining dark brown unarmed umbo. Seed ovoid, compressed, mottled brown, about $\frac{1}{8}$ in. long; wing pale brown, $\frac{3}{4}$ in. long; cotyledons six or seven.

This species is only liable to be confused with *P. Laricio*, which it resembles in the branchlets and general appearance of the foliage; but is readily distinguished by the long basal sheaths of the leaves, the resin-canals of the latter being marginal and not median as in *P. Laricio*.

### Distribution

The red pine is the representative of *P. sylvestris* in Canada, and the northern border of the United States, where it is often called "Norway Pine," its northern limit extending from Lake St. John in Quebec, lat. 48°, westwards through central Ottawa to the southern end of Lake Winnipeg. In Quebec it forms thick groves on sandy and gravelly hills, and the forests still uncut contain an immense quantity of lumber of this species.[2] On dry ridges near Toronto, Elwes saw trees over 90 ft. high, with clean stems to 50 or 60 ft.

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[1] The cones in falling, as I have observed in Minnesota and on cultivated trees at Bayfordbury, leave some of the basal scales and the short stalk on the branchlet.

[2] J. C. Langelier, in *Canadian Forestry Association, Sixth Ann. Report*, 69 (1905), estimates the timber of this pine still standing in Quebec, at 7500 million feet board measure.

The tree extends southwards through Nova Scotia, New Brunswick, Maine,[1] New Hampshire, and Vermont, becoming very rare and local in Massachusetts, and reaching its most southern limit in the mountains of Chester County, Pennsylvania. In New Hampshire[2] it occurs mainly in the low sandy country in the Saco river basin, where it either grows pure or in mixture with *P. Strobus*. In the Pisgah forest, near Hinsdale, in this state, I saw in 1906 a few trees growing on rocky ridges, one of which measured 94 ft. by 7½ ft.

It extends westwards, through north-eastern Ohio, north of Cleveland; and in central Michigan, northern Wisconsin, and north-eastern Minnesota, attains its greatest abundance and largest size. In northern Wisconsin,[3] it grows mixed with *P. Strobus* on loamy sands; and either pure or mixed with *P. Banksiana*, occupies the poorer lands, which are known as pine barrens. It is occasionally met with on clay soils on the slopes along Lake Superior. It grows rapidly when young, about as fast as *P. Strobus* up to the age of 100 years; but afterwards increases very slowly in diameter. In the Cass Lake Forest Reserve in Minnesota, it occurs in similar situations, and is the timber chiefly valued for beams, that of *P. Strobus* being almost entirely used for indoor finish. *P. resinosa*, in pure stands in this state, has very straight stems, free of branches to a great height. Tables that I obtained in Washington show that in Itasca County, Minnesota, and in Bayfield County, Wisconsin, trees occur 120 ft. in height and 30 in. in diameter; and at 200 years old, they average 26 in. in diameter.

This species is very intolerant of shade at all ages; and in America,[4] where it is occasionally planted, is either used pure, or in mixture with *P. Strobus*. Measurements made of plantations near Lake Winnepesaukee in New Hampshire, show that at twenty-seven years old the red pine averages 35 ft. high, and is taller than white pine of the same age. (A. H.)

Bailey and Jack in a paper "In the Woods of New Brunswick,"[5] say of this pine that lumbermen recognise two varieties, which they call "Sapling" and "Old Red Pine." The former has an inferior timber, which, however, was largely used in Maine for hogshead heading. The latter, nearly extinct in 1887, sometimes attained a height of 90 ft., and a diameter of 3 ft., clean to 40 or 50 ft. up. The wood is strong and durable, resembling that of pitch pine, but with less resin, and was formerly largely employed for the decking of vessels and for beams, having a fine compact grain with few knots. It grew best on dry and sandy soil, in the granite boulder country fifty miles north of St. Andrews, and also on the Tobique river, where in some places the trees were so thick that there was hardly room to turn a sled between the stumps.

In *Canadian Forestry Journal*, 1905, p. 172, two illustrations are given of a remarkable instance of a tree of this species, from which a ring of bark 1 ft. wide was removed all round the tree nine years previously. The tree was still alive, and had made an increase in girth of 6 in. above the place where it was girdled. Mr. A. Knechtel, at that time forester to the New York Forest, Fish, and Game Commission, found this tree close to the road from Paul Smith's to M'Colloms' in the Adirondack mountains, and gave the dimensions as follows:—Height, 30 ft.; diameter of girdled part, 5 ft. 3 in.; ditto, just below the girdle, 6 ft. 4 in.; ditto, just above, 8 ft. 3 in. Mr. Knechtel writes me on May 10, 1909, that the tree was still alive when he last saw it in October 1908, and explains the fact as follows:—"The plant food ascends the tree through its interior; the elaborated material descends between wood and bark. Since there is no bark at the girdle, it does not cross it. Hence the tree grows above the girdle and not below it."

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[1] It is common in Maine, generally on dry ridges, but in Greenbush and Passadumkeag grows abundantly on peat bog with black spruce. Dame and Brooks, *Trees of New England*, 10 (1902).

[2] Chittenden, *Forest Conditions of New Hampshire*, *U.S. Forestry Bulletin* No. 55, p. 54 (1905).

[3] Roth, in *Wisconsin Geol. Survey Bull.* No. 1, *Forestry Conditions of Northern Wisconsin*, 20, 67 (1898).

[4] *U.S. Forest Service Circ.* 60 (1907).

[5] *Trans. Scot. Arb. Soc.* xi. 11 (1887).

### CULTIVATION

It was introduced[1] by Hugh, Duke of Northumberland, as long ago as 1756; but it seems unable to live long or to attain timber size in any part of this country. Lambert says that in 1804 he found it in a flourishing state at Pains Hill, at Caen Wood (in a small island), and at Syon, where the first trees were planted, yet from their size he concluded that it would not produce valuable timber. At White Knights a number of trees were planted by the Marquess of Blandford about the end of the eighteenth century, raised by Loddiges from seeds received from America, and some of them existed in Loudon's time. But at these places none are now living; and the only trees we have seen are two specimens at Bayfordbury, planted in 1851, one of which is 54 ft. high and 5 ft. 3 in. in girth, and the other 50 ft. by 3 ft. 10 in.; two trees at Dropmore, 68 ft. by 4 ft. 5 in., and 62 ft. by 4 ft. 3 in. in 1909; and one or two small trees at Kew. In my nursery at Colesborne small imported trees closely resemble the Austrian pine, but are far less vigorous in growth, and have been gradually dying ever since I had them.

### TIMBER

The timber of this tree was at one time imported to a considerable extent, and according to Laslett was then known as red pine, and when straight and clean enough for masts was considered superior to the Riga and Dantzic pines for that purpose.

Macoun says that it is neither so tall nor so large as the white pine (*P. Strobus*), and that though the wood is much harder, stronger, more elastic and resinous, is often not separated in commerce from the wood[2] of that species. It is valuable for piles, masts, and spars, and though formerly worth more than white pine, is not nearly so abundant in Canada.

Mr. Weale writes as follows:—"Canadian red pine (*Pinus resinosa*) is produced in Canada generally, but not largely imported into this country owing to the competition of the Baltic *Pinus sylvestris*. It is harder and not so easily worked as yellow pine (*Pinus Strobus*), and not so hard as pitch pine (*Pinus palustris*). For work that needs much application of the tool the yellow pine is therefore preferred. On the other hand, where long lengths, hardness, and durability are required, consumers employ the pitch pine. The Canadian red pine in consequence does not find the ready market in Great Britain it deserves."

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[1] Aiton, *Hort. Kew.* iii. 367 (1789).

[2] Dr. H. T. Bovey, in *Trans. Roy. Soc. Canada*, xii. 3, p. 11 (1894), gives the results of tests on the comparative strength of red pine, white pine, and Douglas fir.

Mayr gives a comparison between the wood of a tree of this species felled in Dakota and a tree of *P. sylvestris* felled in Bavaria; the latter had heavier wood with less sapwood, but contained a less percentage of resin. (H. J. E.)

## PINUS THUNBERGII, Japanese Black Pine

*Pinus Thunbergii*, Parlatore, in DC., *Prod.* xvi. 2, p. 388 (1868); Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 504 (1881), xxvi. 552 (1902), and xxxv. 629 (1904), and in *Gard. Chron.* xxiii. 344, fig. 63 (1885); Mayr, *Abiet. jap. Reiches*, 69, t. v. f. 16, and t. vii. f. 1 (1890), and *Fremdländ. Wald- u. Parkbäume*, 350 (1906); Shirasawa, *Icon. Forest. Japon*, text 11, t. i. ff. 15-29 (1899); Kent, Veitch's *Man. Coniferæ*, 383 (1900); Clinton-Baker, *Illust. Conif.* i. 55 (1909).

*Pinus Massoniana*, Siebold et Zuccarini, *Fl. Jap.* ii. 24, t. 113 (1844) (not Lambert).

A tree, attaining in Japan 130 ft. in height and 20 ft. in girth. Bark greyish brown, deeply fissured. Young branchlets glabrous, brown, with slightly raised pulvini, bearing at their apices long lanceolate-acuminate fimbriated scale-leaves, persisting during the first year, and leaving, when they fall, transverse projecting ridges, roughening the older branchlets. Buds ovoid, cuspidate, ½ to ¾ in. long, greyish white; scales appressed and matted together by their fimbriated edges, and ending in long subulate points.

Leaves in pairs, persistent for three years, densely crowded on the branchlets, more or less spreading, 3 to 4 in. long, rigid, twisted half a turn, so that the apices of the two leaves in each cluster face each other by their outer surfaces, serrulate, ending in a spine-like cartilaginous point, marked with numerous stomatic lines on both surfaces; resin-canals median; basal sheath ½ in. long, ending above in two long filaments.

Cones sub-terminal, spreading, clustered, on short stalks, ovoid-conic, about 2½ in. long; scales oblong-cuneate, thin, concave laterally, with the concealed part dark reddish brown on the outer and pale brown on the inner surface; apophysis thickened, rhomboidal, shining brown, upper edge irregular, depressed in the centre, with numerous radial lines, transverse ridge slightly marked, umbo reddish brown or white with resin, armed with a minute, often rudimentary prickle. Seed greyish or brown, mottled with black, ⅕ to ¼ in. long; wing narrow, pale brown, about ¾ in. long.

This species, which is the representative of *P. Laricio* in Japan, is readily distinguished by its remarkable white buds and rigid needles. The long filaments of the basal sheaths are peculiar to this species and *P. densiflora*.

Mayr describes ten varieties which are cultivated in Japanese gardens. In var. *monophylla* the two leaves in the cluster coalesce. Forms of peculiar habit are known, globose or pendulous, or with twisted stems. Var. *aurea*, in which the leaves assume a golden yellow colour during winter, and var. *variegata*, in which the leaves are marked with one or two transverse yellow bands about the middle, were introduced[1] into Kew Gardens in 1897.

According to Mayr, this species forms hybrids with *P. densiflora*.

(A. H.)

## DISTRIBUTION

This species is restricted to Japan,[2] where, according to Shirasawa and Mayr, it is only known in the wild state on the eastern sea-coast, from Kiusiu and Shikoku to the northern part of Hondo. On account of the dark grey bark, uniform in colour to the top of the tree, it is usually called *kuro-matsu* or black pine by the Japanese. Commonly forming a stout trunk, with irregular wide-spreading strong branches, it is also termed *o-matsu*, or male pine, in contradistinction to *P. densiflora*, which, from its more slender stem and more graceful appearance, is named female pine. Varied and picturesque in appearance, the black pine is frequently depicted by Japanese artists.

It is one of the trees which has been planted from a very early period in gardens and about temples. The most celebrated tree of the species grows on the shore of Lake Biwa at Karasaki, which is easily reached in two hours from Kioto, and is well worth a visit. It is certainly a remarkable tree, though nothing like so large as stated in Murray's *Handbook to Japan* (1903).[3] The correct measurement, as taken by myself, is as follows:—Girth at ground, 20 ft.; at 5 ft., where a very large limb is already thrown off, 29 ft. The largest limbs are about 12 ft. each in girth, and the main trunk above them about 20 ft. high. The highest branch that I could find on the tree is not over 50 ft. from the ground, but the spread is astonishing. As nearly as I could follow the extremities of the branches, they cover an area 180 paces round, and though the tree is decayed in places and is said to be a thousand years old, it is full of foliage and had many cones which bear fertile seeds.

Another famous tree at the Naniwaga tea-house in Osaka, seen by Siebold, had the branches artificially extended, and formed a circuit of 135 paces.

This pine is also largely planted for timber in Japan, and is of great service near the sea-coast for fixing the dunes and for shelter belts. It will grow in the poorest soil, but then remains dwarf and of no value unless planted wide apart. On good soils it attains enormous dimensions, Mayr recording a tree 140 ft. in height and 11 ft. in girth. The timber is difficult to work, and inferior in quality to that of *P. densiflora,* but is superior for firewood and yields resin.

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[1] *Gard. Chron.* xxi. 250 (1897). These varieties cannot now be found.

[2] A pine, widely spread in the mountains of northern Korea, and of the Manchurian provinces, S. Ussuri, Kirin, and Mukden, has long been confused with *P. Thunbergii*, and has only lately been accurately described as a distinct species—*Pinus funebris*, Komarov, *Flora Manshuriæ*, i. 177 (1901). The leaves of this species differ in having marginal resin-canals; and the buds are reddish, ovoid, short-pointed, with appressed scales. The cones, similar in size to those of *P. Thunbergii*, differ in the greyish apophyses of the scales, each of which has an elevated umbo, ending in an inflexed short point. The seeds are shining dark brown, with short broad wings. This pine resembles in stature *P. sylvestris*, but has ashy grey coloured bark. It is often planted in Korea and Manchuria, and in the vicinity of Peking, around temples and tombs; but has not yet been introduced into this country. It is erroneously referred to *P. Thunbergii* by Masters in *Journ. Linn. Soc.* (*Bot.*) xxvi. 553 (1902).

The specimens from Yunnan and eastern Szechwan referred to *P. Thunbergii* by Franchet, in *Journ. de Bot.* xiii. 253 (1899), are certainly not this species.—(A. H.)

[3] A photograph of this remarkable specimen, sent by Sir Thomas Hanbury, who considered it to be *P. densiflora*, is reproduced in *Gard. Chron.* xv. 366, fig. 44 (1894). Another remarkable pine, either *P. Thunbergii* or *P. densiflora*, is figured in *Gard. Chron.* xv. 140, fig. 15 (1894). This stands in the Kinkakuji monastery in Kioto, and is trained to represent a junk with a mast and sail. Cf. Kent, Veitch's *Man. Coniferæ*, 385, fig. (1900).

### CULTIVATION

*P. Thunbergii* was introduced into Holland by Siebold in 1855, and into England by J. Gould Veitch in 1861. It is often seen in private collections and botanic gardens, as at Kew, Glasnevin, and Bayfordbury; but nowhere has attained considerable dimensions, the finest specimen being one at Dropmore, planted in 1861, which was 52 ft. high by 6 ft. in girth in 1909. There are two trees at Eastnor Castle, the larger of which is 48 ft. by 5 ft., and the smaller 42 ft. by 3 ft. 5 in. Another at Grayswood, near Haslemere, planted in 1881, is a wide-spreading tree, 39 ft. in height and 4 ft. 3 in. girth in 1906. It gives little promise of being a useful tree for planters, though it might be tried near the sea-coast. Lord de Saumarez wrote in 1897 to Kew that he had found this species invaluable for planting in Guernsey on the most exposed points close to the sea, where all other pines, including *P. Pinaster,* had failed. In 1909, trees planted twenty years had attained 25 ft. in height. At Grafrath, near Munich, it is slow in growth and much injured by snow, a tree twenty-five years old being only 13 ft. high. In New England it is perfectly hardy. (H. J. E.)

# CUPRESSUS

*Cupressus*,[1] Linnæus, *Gen. Pl.* 294 (1737); Stark, in *Trans. Roy. Soc. Edin.* xxvii. 651 (1876); Bentham et Hooker, *Gen. Pl.* iii. 427 (1880); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxx. 18 (1893), and xxxi. 312-363 (1896).
*Chamæcyparis*, Spach, *Hist. Vég.* xi. 329 (1842).
*Retinispora*,[2] Siebold et Zuccarini, *Fl. Jap.* ii. 36 (1844).
*Thuya*, section *Chamæcyparis*, Bentham et Hooker, *Gen. Pl.* iii. 427 (1880).

EVERGREEN trees, or rarely shrubs, belonging to the division Cupressineæ of the order Coniferæ. Bark[3] usually divided into ridges, and separating on the surface into loose or appressed scales. Branches, ascending or spreading, much ramified, and terminating in so-called "branchlet systems" or "herbaceous shoots," which are green in colour, two- or three-pinnately divided, and covered with scale-like leaves; most of the branchlet systems[4] are deciduous in the third or fourth year, a few developing by their main axes into permanent branches. Ultimate branchlets slender, quadrangular or flattened. Leaves on adult trees, minute, more or less coalesced with the axes, ovate, with spreading or appressed tips, in four rows, in opposite decussate pairs, around the branchlets; either (*a*) all uniform in size and shape, or (*b*) of two kinds, a flattened pair on the front and back of the branchlet, and a lateral conduplicate pair. On vigorous leading shoots and on seedling plants the leaves are needle-shaped or linear-lanceolate, spreading, and uniform in four ranks. In certain horticultural varieties, formerly considered to be species of a distinct genus, *Retinispora*, the foliage either resembles that of seedling plants or is intermediate in character between the primordial and the adult foliage.

Flowers monœcious, terminal, solitary, the two sexes on separate branches. Staminate flowers cylindrical, composed of numerous decussate stamens, with short filaments, enlarged into ovate connectives bearing two to six pendulous globose anther-cells. Pistillate flowers, composed of decussate peltate scales, in which no distinction between the "ovuliferous scale" and the "cover-scale" or "bract" is apparent, continuous in series with the leaves at the end of the branchlet, and bearing either (*a*) in one row, two to five, or (*b*) in several rows, numerous erect urceolate ovules. Fruit, a globose cone, composed of four to fourteen woody peltate scales, abruptly dilated at the apex, and bearing in the centre of the outer surface a mucro, boss, or knob. Seeds erect on the base of the scale, acutely angled, compressed or rounded, with two thin lateral wings.

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[1] We are indebted to Mr. Cecil Hanbury for a fine set of specimens, sent by Mr. Berger from La Mortola on the Italian Riviera, and to Mr. Flahault for a set of all the species cultivated at Montpellier.

[2] This name was first applied to the Japanese species, which have conspicuous resin-vesicles on their seeds. (*C. Lawsoniana*, discovered afterwards, has the same character.) It is derived from ῥητίνη, resin, and σπορά, seed. Subsequently it was wrongly spelled *Retinospora*, and was made to comprise the juvenile forms of Cupressus and Thuya.

[3] The bark of *C. Lawsoniana*, q.v., differs remarkably on old trees from that of all the other species.

[4] A "branchlet system" arises from a bud, and forms in the first year an axis and secondary lateral branchlets; in the second year tertiary branchlets are developed. The branchlet system usually falls off in October of the third year, but in certain species the fall is in the second or in the fourth year; in the latter case the tertiary branchlets develop another set of branchlets.

The genus consists of about fifteen species,[1] widely distributed throughout the warm temperate region of the northern hemisphere ; and is divided into two sections, which are by many authors considered to be two distinct genera. The only constant difference between the sections appears to lie in the margin of the leaves. The different periods of ripening of the cones, the number of seeds on each scale, and the flattened or tetragonal branchlets, are too variable to form any real base of distinction. Penhallow[2] points out that while the microscopic structure of the wood of *Cupressus* and *Thuya* is distinct, there is no difference in the wood of *Cupressus* and *Chamæcyparis* ; and considers that the latter must disappear as a genus.

About fourteen species are in cultivation, which are distinguishable as follows :—

## I. EU-CUPRESSUS.

Leaves, fringed with a narrow thin translucent serrated border,[3] either uniform in four ranks, or dimorphic with conduplicate lateral pairs and flattened facial pairs. Branchlet systems either flattened with their pinnæ in one plane, or arising at varying angles with their pinnæ in several planes. Cones large,[4] usually ½ in. or more in diameter, ripening in the second year. Seeds,[4] usually six to twenty on each scale, in several rows. Cotyledons two to five.

### A. *Branchlet-systems flattened with the pinnæ in one plane.*

#### * *Leaves appressed.*

1. *Cupressus torulosa*, Don. Western Himalayas. See p. 1158.

Branchlets equal-sided. Leaves obtuse, uniform in four ranks. Cones, ½ in., globose or ellipsoid, on short usually curved stalks ; scales eight or ten, external surface depressed, with a minute process. Seeds six to eight on each scale.

2. *Cupressus funebris*, Endlicher. China. See p. 1162.

Branchlets compressed. Leaves dimorphic, non-glandular, with a mucronate scarcely spreading apex. Cones,[4] ⅓ in., globose, on long slender stalks ; scales eight, external surface not depressed, with a minute process. Seeds three to five on each scale.

2A. *Cupressus lusitanica*, Miller, var. *Benthami*, Carrière. Mexico. See p. 1177.

Branchlets compressed. Leaves dimorphic, usually with a depressed circular gland, apices mucronate and spreading. Cones and seeds as in *C. lusitanica*.

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[1] *Dacrydium Franklini*, Hooker, the Huon pine, a native of Tasmania, which is occasionally cultivated in the west of Scotland and in Cornwall, is frequently mistaken for a cypress. On close examination the leaves, which are dotted over with white stomata, will be seen to be spirally arranged, and not in opposite decussate pairs, as in *Cupressus*.

[2] In *Trans. Roy. Soc. Canada*, ii. § 4, p. 43 (1896).

[3] This narrow serrated border can only be seen with a lens of considerable magnifying power.

[4] *C. funebris* is exceptional in its small cones with few seeds on each scale, and is a link between the two sections.

** *Leaves spreading.*

3. *Cupressus cashmeriana*, Royle. Himalayas. See p. 1161.

Branchlets compressed. Leaves glaucous-blue, widely spreading above their decurrent base, subulate, with a mucronate apex. Cones, $\frac{1}{2}$ in., ellipsoidal; scales ten, outer surface depressed, with a minute reflexed process. Seeds ten on each scale.

B. *Branchlet-systems arising at varying angles, with their pinnæ not in one plane.*

* *Leaves with a conspicuous circular pit, exuding resin.*

4. *Cupressus Macnabiana*, Murray. California. See p. 1174.

Branchlets compressed. Leaves dimorphic, thick, obtuse. Cones globose, $\frac{1}{2}$ to $\frac{3}{4}$ in., reddish brown, often glaucous; scales six, with prominent processes, those on the upper scales thickened, conical, and incurved. Seeds ten to twelve on each scale.

5. *Cupressus arizonica*, Greene. Arizona, Northern Mexico. See p. 1183.

Branchlets equal-sided, glaucous in native specimens. Leaves uniform, acute or acuminate. Cones, $\frac{1}{2}$ to $\frac{3}{4}$ in., glaucous at least in the first year; scales six to eight, with the external surface not depressed, and a prominent process. Seeds eight to ten on each scale.

** *Leaves not conspicuously glandular.*

† *Branchlets equal-sided. Leaves uniform in four ranks, closely appressed.*

6. *Cupressus sempervirens*, Linnæus. Mediterranean region. See p. 1151.

Leaves $\frac{1}{25}$ in. long, obtuse. Cones sub-globose or ovoid, 1 to $1\frac{1}{4}$ in., pale brown or greyish; scales eight to fourteen, either with a central pit overhung by a minute process, or pyramidate ending in a mucronate process. Seeds twenty on each scale.

7. *Cupressus macrocarpa*, Hartweg. Monterey (California) and Guadalupe Island. See p. 1165.

Leaves $\frac{1}{16}$ in. long, obtuse, swollen towards the tip. Cones ellipsoid, 1 to $1\frac{1}{4}$ in. long, shining reddish brown; scales eight to fourteen, with a central depression overhung by a thin-edged ridge-like arcuate process. Seeds twenty on each scale.

8. *Cupressus Goveniana*, Gordon. California. See p. 1171.

Leaves $\frac{1}{25}$ to $\frac{1}{20}$ in. long, swollen near the apex, which is acute and often mucronate. Cones globose, $\frac{1}{2}$ to $\frac{3}{4}$ in., shining dark brown; scales six to ten, projecting in the centre, which bears a prominent process. Seeds ten to twelve on each scale.

‡ *Branchlets compressed. Leaves nearly uniform in four ranks,*
*free at the tips.*

9. *Cupressus lusitanica*, Miller. Mexico, long cultivated in Portugal. See p. 1176.

Leaves $\frac{1}{16}$ in. long, acuminate, often mucronate. Cones remarkably glaucous, at least in the first year, globose, $\frac{1}{2}$ in., on straight stalks; scales eight, with a prominent process. Seeds eight to ten on each scale.

## II. CHAMÆCYPARIS.

Leaves entire in margin; always dimorphic, lateral pair conduplicate, facial pair flattened. Branchlet systems usually flattened, with their pinnæ in one plane. Cones small, not more that ⅓ in. in diameter, usually ripening[1] in one year. Seeds one to five on each scale, in one row. Cotyledons invariably two.

### A. *Lateral leaves much larger than the dorsi-ventral leaves, longer than them on the main axes.*

10. *Cupressus obtusa*, Koch. Japan, Formosa. See p. 1185.

Leaves obtuse, non-glandular. Under surface of the foliage marked with x-shaped clearly-defined white markings. Cones ⅓ in., orange-brown; scales eight or ten. Seeds one to five on each scale, with large conspicuous resin-vesicles.

11. *Cupressus Lawsoniana*, Murray. South-western Oregon, north-western California. See p. 1200.

Leaves acute, usually glandular. Under surface of the foliage green or with ill-defined white markings. Cones ⅓ in., glaucous; scales eight. Seeds two to five on each scale, with large conspicuous resin-vesicles.

### B. *Lateral leaves not much larger than the dorsi-ventral leaves, equal in length with them on the main axes.*

12. *Cupressus pisifera*, Koch. Japan. See p. 1190.

Leaves acuminate, with spreading often mucronate tips, obscurely glandular. Lower surface of the foliage with white markings in hollows of the leaves. Cones ¼ in., dark brown; scales ten, wrinkled and deeply depressed in the centre. Seeds one to two on each scale, with large conspicuous resin-vesicles.

13. *Cupressus nootkatensis*, Don. Alaska, British Columbia, Washington, Northern Oregon. See p. 1194.

Leaves acute, mucronate, green, without any white markings. Cones ripening in the second year, ⅓ in., plum-coloured; scales four or six, with prominent pointed processes. Seeds two on each scale, without resin-vesicles.

14. *Cupressus thyoides*, Linnæus. Near the sea from southern Maine to northern Florida, and westward to Mississippi. See p. 1210.

Leaves acute, green, without white markings, with a conspicuous raised gland on the back. Cones ¼ in., glaucous; scales six. Seeds one to two on each scale, without resin-vesicles.

The following species are not yet introduced, and are imperfectly known.

CUPRESSUS FORMOSENSIS, Henry.

*Chamæcyparis formosensis*, Matsumura, in *Tokyo Bot. Mag.* xv. 137 (1901); Matsumura and Hayata, *Enum. Pl. Formos.* 402 (1906); Beissner, in *Mitt. deut. dendr. Ges.* 1907, p. 115; Hayata, in *Journ. Coll. Sc. Tokyo*, xxv. 208 (1908).

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[1] *C. nootkatensis* is an exception. Cf. p. 1196, note 4.

This species, which occurs on Mount Morrison in Formosa, at 7000 to 10,000 feet altitude, appears to be allied to *C. Lawsoniana*, and is reported to attain an enormous size, Beissner having received from A. Unger of Yokohama a photograph of a tree said to be 72 feet in girth.[1] There are herbarium specimens at Berlin, which I have not seen. It is described as having acute green leaves not marked with white lines as in *C. pisifera*; and the cones are intermediate in size between those of that species and those of *C. obtusa*. No seeds of this remarkable species have as yet reached Europe.

Cupressus Hodginsii, Dunn, in *Journ. Linn. Soc.* (*Bot.*) xxxviii. 367 (1908).

Described[2] from specimens collected near Foochow, China, consisting of detached foliage and cones. The former resembles the foliage of young trees of *Libocedrus macrolepis* in cultivation at Kew. The cones are very peculiar, resembling those of a cypress, but containing seeds with two very unequal wings, and indicate a new and interesting species, doubtfully referable to *Cupressus*.

Cupressus thurifera, Humboldt, Bonpland, and Kunth, *Nov. Sp. et Gen.* ii. 3 (1817); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 349, figs. 25-27 (1896); Kent, Veitch's *Man. Conif.* 230 (1900).

*Chamæcyparis thurifera*, Endlicher, *Syn. Conif.* 62 (1847).

A rare species, recorded for three or four localities in Mexico, and doubtfully referable to *Cupressus*. There are cones in the Kew herbarium collected by Botteri[3] at Orizaba which were attributed to this species by Dr. Masters. These cones are globose, composed of six non-peltate scales, decussately arranged, and fitting close together by their margins; each scale bears the scars of attachment of one to three wingless seeds. Kent described this species from specimens, said to have been sent from La Mortola, but which cannot now be found in Messrs. Veitch's museum at Chelsea; and Mr. A. Berger writes[4] that no tree of this kind now exists at La Mortola. It is doubtful if this species was ever introduced, as Carrière[5] states that the plant formerly grown under this name was a *Biota*; and seeds of supposed *C. thurifera*, distributed in 1909, by the Dendrological Society of France, differed in no respect from those of *C. lusitanica*. (A. H.)

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[1] While these pages were finally going through the press, Mr. H. Clinton-Baker has shown me a photograph, taken by Mr. A. R. Firth, Consul at Tamsui, of an enormous tree of this species, growing on Mt. Ari, which measures 125 ft. in height, with a stem free of branches for 45 ft. and 67 ft. in girth. Capt. L. Clinton-Baker, R.N., has just brought home excellent specimens in fruit, and two living plants, which will be planted at Bayfordbury.

[2] While these pages were finally going through the press, Mr. H. Clinton-Baker has received from Capt. Hodgins, excellent specimens in fruit. There are now four living plants at Bayfordbury, two sent in 1909, and two brought home in April 1910, by Capt. L. Clinton-Baker, R.N.

[3] Lindley, in *Gard. Chron.* 1856, p. 772, states that Botteri sent cones of a cultivated plant, from which very glaucous seedlings like a Thuya were raised in the Chiswick Garden.

[4] Mr. Berger states that two plants formerly cultivated under this name at La Mortola turned out to be *Cupressus sempervirens* and *C. lusitanica*, var. *Benthami*.

[5] *Conif.* 135 (1867).

## CUPRESSUS SEMPERVIRENS, Mediterranean Cypress

*Cupressus sempervirens*, Linnæus, *Sp. Pl.* 1002 (1753); Pallas, *Fl. Ross*, I. pt. ii. p. 11, t. 53 (1784); Loudon, *Arb. et Frut. Brit.* iv. 2464 (1838); Boissier, *Fl. Orient.* v. 705 (1881); Hooker, *Fl. Brit. Ind.* v. 645 (1888); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 325 (1896); Kent, Veitch's *Man. Coniferæ*, 228 (1900); Gamble, *Indian Timbers*, 697 (1902); Kirchner, *Lebengesch. Blütenpfl. Mitteleurop.* i. 280 (1906).
*Cupressus horizontalis*, Miller, *Dict.* No. 2 (1768), sphalmate "*horizontalibus.*"
*Cupressus lugubris*, Salisbury, *Prod.* 397 (1796).
*Cupressus fastigiata*, De Candolle, *Flor. Franç.* vi. 336 (1815).
*Cupressus patula*, Spadoni, *Xilog.* i. 193 (1826).
*Cupressus Tournefortii*, Audibert, *Cat.* (1834).

A tree, attaining in the Mediterranean region an immense age and size. Bark very thin, even on old trees, smooth or slightly fissured longitudinally, greyish brown, with a light brown cortex. Branchlet systems, alternate, not distichous, spreading irregularly at varying angles, tri-pinnate, with the pinnæ not disposed in one plane. Ultimate branchlets tetragonal, equal-sided, $\frac{1}{28}$ in. in diameter. Leaves, in four equal ranks, $\frac{1}{25}$ in. long, rhomboid, obtuse, closely appressed, often marked with a longitudinal furrow.

Staminate flowers, yellow, $\frac{1}{6}$ in. long; stamens about ten pairs, with sub-orbicular dentate connectives, each of which bears four or more anther-cells. Female flowers globose, $\frac{1}{4}$ in. in diameter; scales decussate, three to seven pairs, thick and fleshy with a thin edge, and bearing at the base about twenty urn-shaped ovules.

Cones ripening in the winter of the first year or in the following spring, opening in the succeeding autumn by the separation of the scales at their edges, when the seed falls out; on short stout curved stalks, sub-globose or ovoid, 1 to $1\frac{1}{4}$ in. in length, shining, pale brown or greyish; scales eight to fourteen, very variable in form, either flattened with a central pit overhung by a minute rounded thin process, or pyramidate with a mucronate process. Seeds eight to twenty on each scale, $\frac{1}{6}$ in. long, oblong, rounded or angled, without resin-vesicles; wing very narrow.

The seedling[1] has two opposite cotyledons, $\frac{2}{5}$ in. long, linear, flattened, shining green below, and dull bluish green above with stomata. The primary leaves, $\frac{1}{8}$ in. long, green and spreading, have stomata on their upper surface; the first pair opposite and alternating with the cotyledons, and followed by a series of whorls of four, ultimately being replaced by decussate pairs of adult scale-like leaves.

### Varieties

The Mediterranean cypress has been known to exist from the most ancient times in two forms.

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[1] Cf. Kirchner, *op. cit.* 281, 282.

1. Var. *horizontalis*, Gordon, *Pinetum*, 68 (1858).

*Cupressus horizontalis*, Miller, *Dict.* No. 2 (1768).

Branches spreading, the tree assuming the habit of a cedar. This is the common form in the wild state.

2. Var. *stricta*, Aiton, *Hort. Kew.* iii. 372 (1789).

Var. *pyramidalis*, Nyman, *Consp.* 675 (1881).
Var. *fastigiata*, Hansen, in *Journ. Roy. Hort. Soc.* xiv. 287 (1892).
*Cupressus pyramidalis*, Targioni-Tozzetti, *Oss. Bot.* iii.-v. 53 (1808).
*Cupressus fastigiata*, De Candolle, *Fl. Franç.* v. 336 (1815).
*Cupressus conoidea*, Spadoni, *Xilog.* i. 189 (1826).

Branches erect, nearly parallel to the stem, forming a tree of narrowly pyramidal outline. This is the form most commonly met with in cultivation.

It is doubtful if the varieties, which depend upon the form of the fruit, though distinguished by Parlatore, can be maintained, as he admits that he observed on the same tree cones of different shapes, ovate-oblong, oblong, and globose, with both umbonate and umbilicate scales. The following may be mentioned, although it is extremely doubtful if it can be distinguished in cultivation.

3. Var. *indica*, Parlatore, in De Candolle, *Prod.* xvi. pt. ii. p. 469 (1868).

*Cupressus Whitleyana*, Carrière, *Conif.* 128 (1855).
*Cupressus Doniana*, *Royleana*, and *australis*, Koch, *Dendrologie*, II. pt. ii. p. 146 (1873)

Habit of var. *stricta*, with globose cones and mucronate umbonate scales. This variety as well as the spreading form is cultivated in northern India.

4. Variegated and dwarf varieties, which we have not seen, are mentioned by Carrière.

5. Var. *thujæfolia*, Knight and Perry, *Syn. Conif.* 19 (1850).

A sub-variety of the upright cypress, in which the branchlet systems are regularly arranged in one plane.

## DISTRIBUTION

This species is indigenous in the mountains of northern Persia, in Syria, Cilicia, Greece, and the islands of Rhodes, Crete, and Cyprus. Pliny believed that it was introduced from Crete into Italy. Humboldt considered the native home of the cypress to be in the mountains of Buseh, west of Herat, but so far as our present knowledge goes it is now a rare and always a planted tree in Afghanistan. Hehn's[1] supposition that it was in ancient times imported from Persia into the Lebanon and Cyprus is without any foundation.[2]

Dr. Stapf informs me that this tree is truly wild in the Elburz mountains in northern Persia, where he saw it on rocky slopes opposite Mendjil and Rudbar. Buhse collected it on the sides of the Safed Rud valley.

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[1] *Wanderings of Plants and Animals*, 212.

[2] Mouillefert, *Essences Forestières*, 402 (1903), identifies with this species some pieces of wood found at Carthage, which had been used for coffins by the Carthaginians about 500 B.C. At present the tree only exists in Algeria near houses and in gardens.

In Greece,[1] it is now found wild on Mount Parnassus and forms woods between Messene and Kalamata in Peloponnesus.

In Cyprus,[2] the spreading form of the cypress, var. *horizontalis*, grows in a wild state throughout the northern range of mountains, which consist mainly of limestone, thriving luxuriantly up to the highest point, 3300 ft. above sea-level. There are no large trees now in the forests of this range, the best being about 35 ft. high and 5 ft. in girth, since in former times, whenever a tree was large enough to make a rafter it was cut by the villagers, and much damage was also done by forest fires. In the southern range, which is mainly composed of volcanic rocks, there are only a few isolated specimens, which ascend to 3500 ft. elevation. The fastigiate variety is commonly planted in gardens in the plains; and the finest specimens are one at the Ayia Nicola church in the Famagusta district, 70 ft. high and 9½ ft. in girth; another of the same height and 12 ft. in girth at the Chrysostomos monastery, Kyrenia district; while a third at the Ayia Katerina mosque, in the Nicosia district, is 78 ft. by 7 ft. 3 in. Attempts to raise cypress from seed on Troodos at 5500 ft. elevation failed, as the plants were killed by the cold.

According to Pliny,[3] it grew in the White Mountains of Crete, being in great abundance on the very summits, from which the snow never departs. Evelyn[4] states that a vast forest of this species in Crete was destroyed by a fire which raged from 1400 to 1407. Mr. A. Trevor Battye found the horizontal form wild in Crete at elevations of about 3000 ft., attaining about 50 ft. high, by 6 ft. in girth. A photograph taken by him in the entrance to the gorge from the plain of Omalu, shows a group of these trees.

According to Boissier[5] it occurs on the Lebanon between 3500 and 5000 ft., and appears to have been collected in the wild state in northern Syria near Beila, and in the mountains of Cilicia. Post[6] states that the upright variety is everywhere cultivated in the cemeteries in Syria under the name of *Saru*.

The cypress has been carried by man both eastward and westward of its original home, and is occasionally even planted in China.[7] It is much cultivated in northern India, the fastigiate variety being the most common and attaining occasionally a height of 100 ft. with a girth of 9 ft.

The cypress is naturalised in many places, as on the eastern shore of the Adriatic,[8] where, however, it does not thrive at elevations exceeding 1000 ft., and in the Caucasus.[9] In Italy it is perfectly naturalised in Tuscany, where in a mixed wood of oak and ash, between Castelfiorentino and Montagone, Sprenger[10] noticed thousands of trees of all ages from seedlings to a hundred years old.

The cypress is cultivated on the continent in a few places north of the Alps, as on the island of Mainau[11] in Lake Constance, and at Metz; but in France it is commonly planted in Provence and Languedoc about as far north as Valence, and in the south-west; but is not hardy near Paris. Carrière[1] states that the southern slope, on part of which Montpellier is built, appears to have been formerly occupied by an extensive wood of cypress. The remains of the wooden beams are known as *mélèze*, which is the name still used for the cypress by many of the inhabitants of Montpellier. One of these ancient trees still survived in Carrière's time, and was supposed to be 800 years old. It measured 13 ft. in girth at 3 ft. from the ground, and 4 ft. in girth at 71 ft. up, where it had been broken off by lightning. This remarkable tree belonged to the spreading type, and was situated on a property named Mas-Limasson. (A. H.)

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[1] Halácsy, *Consp. Fl. Græcæ*, iii. 454 (1904).

[2] According to a memorandum, prepared by Mr. A. K. Bovill, Principal Forest Officer, kindly sent by the Chief Secretary to Government, Cyprus.

[3] Lib. xvi. cap. xxiii.

[4] *Sylva*, 123 (1679).

[5] *Flora Orientalis*, v. 705 (1881).

[6] *Flora of Syria*, 748 (1896).

[7] Cf. Franchet, *Journ. de Bot.* xiii. 263 (1899).

[8] Beck, *Veg. illyr. Länd.* 184 (1901), with plate representing a grove on the island of Sabioncello.

[9] Radde, *Pflanzenverb. Kaukasus*, 184 (1899).

[10] In *Mitt. deut. dend. Ges.* 1904, p. 195.

[11] A fine tree on this island is figured by Beissner in *Gart. Zeitung*, November 1891.

In January 1910 Professor Flahault showed me at the Colline de la Vallette, about two miles north of Montpellier, on a dry limestone hill, a remarkable wood which was planted in 1810 by Pyrame de Candolle, with cypress. The original trees are supposed to have been cut; and M. Flahault thought that the existing ones are seedlings from them. The difference in habit between the two forms is very marked, and is well shown in the photograph reproduced on Plate 293 A. The best trees of the pyramidal form are about 50 ft. by 4 ft., the average about 35 to 40 ft. Of the horizontal form the best are about 35 ft., the average 20 to 30 ft. There are many small seedlings coming up in the more sheltered parts of this wood, though it is regularly grazed by sheep, and one of these seedlings, though only 3 ft. high, bore fruit. The trees growing with the cypresses are *Pinus halepensis*, which seem to be self sown. In the botanic garden at Montpellier there is a fine specimen of the horizontal form measuring 88 ft. by 8½ ft.

There are large and beautiful trees in the Generalife Gardens at Granada, which are called *cipreses de la reina*. These are supposed[2] to have been planted by the Moors, and are about 500 years old.

The most celebrated cypress in Europe is one at Somma in Lombardy, which is said to have been planted in the year of the Nativity of our Lord. Loudon[3] was informed by the Abbé Belèze that a chronicle exists at Milan, proving it to have existed in 42 B.C. But after having visited the tree I cannot believe that this legend is true, as the tree has no appearance of great age, and I should rather suppose that it is a descendant of some old tree which formerly existed here. Somma is a village about four miles north of Galarate on the railroad from Milan to the Alps, and the tree grows in the corner of a walled garden close to the road, which is said to have been diverted by Napoleon to avoid cutting it down. Manetti, who measured the tree for Loudon, said that[4] it was 121 ft. high and 23 ft. in girth near the ground. I measured it carefully, and found it to be 85 ft. by 17 ft. 3 in. at five feet from the ground. It forks on one side at about 12 ft., and on the other at 15 ft., and then divides into six or seven large trunks. It seemed to be sound, but I could not see into the fork. It is of the *horizontalis* type, and was covered with full-grown but unripe fruit in October 1906.[5]

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[1] *Conif.* ii. 149 (1867).

[2] Willkomm, *Forstl. Flora*, 247 (1887).

[3] *Arb. et Frut. Brit.* iv. 2470, fig. 2325. The figure is copied from a drawing sent to Loudon by Manetti.

[4] Evidently an error, as the Abbé Belèze measured the tree in 1832, and found it to be 70 ft. high and 20 ft. in girth; it had for many years lost its leading shoot. Cf. Loudon, *op. cit.* i. 169 (1838), and *Ann. Soc. d'Hortic.* xii. 76.

[5] The story in Loudon, p. 2471, about this tree being wounded by Francis I. is erroneous, as Loudon points out in pp. 2589, 2605. The tree struck by this king, in his despair after the loss of the battle of Pavia, was a Lombardy poplar. More details about the age and history of this tree will be found in *Notes and Queries*, for Nov. 17, and Dec. 29, 1894.

Sprenger[1] says that this tree grows larger in Tuscany than in the south of Italy, and that he had seen trees on the Lago Maggiore known to be 620 years old, which were over 10 metres in girth near the ground, but I found no such trees myself.

The cypresses in the court of the Diocletian Museum at Rome are said to have been planted by Michael Angelo; and when measured by M. Simond in 1817 the largest was about 13 ft. in girth. Mr. Victor Ames tells me that these are the most picturesque of the fastigiate type that he has seen in Italy. The largest he knows of the *horizontalis* type near Florence are at Marignolle, the tallest at Pozzo Imperiale. Outside the Porta Romana there are some good specimens, which on account of their pendulous growth look like ancient spruce trees. There is a good cypress at Villa d'Este in Tivoli.[2] A tall very slender cypress at La Mortola measured 33 metres by 1½ metres in 1910.

In the garden of Mr. R. Whittaker near Palermo, I saw a tree in 1910 which measured about 85 ft. by 5 ft., 50 years after planting. Its lateral branches were horizontal, and more regular than usual. On the Isola Bella in Lake Maggiore, I measured a very handsome fastigiate tree planted in 1859, which in 1910 was 65 ft. high.

There are very large cypresses at Scutari, where, as generally in Turkey,[3] it is planted abundantly in cemeteries, but I can obtain no exact measurements of the size it attains here.

The largest cypress recorded in Greece was one near Mistra, six miles west of the ruins of Sparta, which Lord Aberdeen[4] found to be 36 ft. in girth at 4 ft. from the ground in 1803. When he saw it again in 1839 it had scarcely gained in girth, and was estimated to be about 150 ft. in height. This immense tree was destroyed[5] by fire lit by gipsies in 1881. Another large cypress at Patras, which Long[6] measured in 1820 as 22 ft. 2 in. in girth at 4 ft. from the ground, was destroyed[7] in the wars of the Greek Revolution. This tree was 18 French ft. in girth in 1676, according to Spon. Prof. Samios of Athens informs us in a letter that the largest specimen he knows of in Greece at the present time is at Oetylos, and measures 50 metres high by 2 metres in girth.

### CULTIVATION

It is uncertain when the cypress was first introduced into England. The first mention that we know of it is by Turner, who was physician at Syon in 1548, and says[8] that it was growing plenteously there. Gerard,[9] in 1597, says that there are trees of it at "Syon, a place neare London, sometime a house of nunnes. It groweth also at Greenwich, and at other places, and likewise at Hampstead, in the garden of Mr. Wade."

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[1] *Mitt. deut. dendr. Ges.* 1904, p. 195.

[2] In *Gard. Chron.* xiii. 752, fig. 130 (1880), an illustration is given of the cypress trees in the Buena Vista Garden at Verona. Cf. also Karsten and Schenck, *Vegetationsbilder*, iii. tt. 23, 24 (1906), for illustrations of this tree at Gardone on Lake Garda.

[3] In. *Gard. Chron.* iii. 48, fig. 11 (1875), the cypresses growing in the garden of the Seraglio at Constantinople are figured.

[4] In Loudon, *Gard. Mag.* xv. 697 (1839), with a figure of the tree, reproduced from a drawing of it made on the spot by Lord Aberdeen.

[5] Willkomm, *Forstliche Flora*, 246 (1887), who gives its height as 170 ft. and its girth as 36 ft.

[6] In Loudon, *Gard. Mag.* xiv. 530 (1838).

[7] Lord Aberdeen, *loc. cit.*

[8] *Names of Herbes*, 32 (1548).

[9] *Herball*, 1185 (1597).

Evelyn[1] says: "Within a few years past, reputed so tender, and so nice a plant, that it was cultivated with the greatest care, and to be found only among the curious, whereas now we see it in every garden, rising to as goodly a bulk and stature, as most which you shall see even in Italy itself; for such I remember to have seen once in his late Majestie's gardens at Theobald's before that Princely seat was demolished."

Evelyn and Boutcher both give instructions for raising the cypress from seed in the open ground, but the latter adds that as it is no uncommon thing for a hard winter to destroy whole beds of them, it is better to sow some seeds in pots.

I have always adopted the latter practice, and have raised many from seeds gathered in Rome, not planting out the seedlings till they are two years old, when they should be about a foot high. In good soil, if not exposed to severe frost, they then make rapid growth,[2] and will be fit to plant out at four years old, though they may be kept in the nursery longer, and successfully transplanted when 5 or 6 ft. high. The seeds will keep good for a very long period; and I have seen at Blackmoor, some trees which were raised from seed collected in the cemetery at Scutari by the present Lord Selborne in 1884. These seeds were sent by him to his father, who kept them in a drawer till 1895, when they were sown, and the young trees in April 1905 were from 10 to 15 ft. high. Though fruit is produced in most parts of England the seed does not always ripen, and I should prefer Italian or French grown seed. The tree should always be planted in well-drained soil, and in the warmest and best-sheltered position that can be found, as it does not thrive and is liable to be killed in severe winters in low-lying or damp situations. A great many trees of considerable size were killed during the severe winters of 1860-61 and 1879-80-81; almost all those in the north and in Scotland, of which Mr. Palmer obtained particulars, having succumbed during the latter period, whilst many old ones in warmer parts of England were injured.

## REMARKABLE TREES

Among the finest cypresses that I have seen in England is one on the lawn at Heron Court (Plate 293), which in 1906 I found to be 60 ft. high by 5 ft. in girth.

At Enville Hall, Staffordshire, Henry measured one which in 1904 was 62 ft. by 9 ft.

In the garden at Langley Hall, Norwich, a tree raised from seed gathered in the Garden of Gethsemane in 1870 by Sir R. Beauchamp was 32 ft. high in 1905.

At Dropmore a tree is 42 ft. high by 5 ft. 9 in. at 3 ft. from the ground.

At Killerton some trees planted near the church about 1841 are from 50 to 60 ft. in height by 4 to 5 ft. in girth.

In the Palace gardens at Wells there is a very broad-topped tree in full vigour about 48 ft. high.

There is a remarkable old tree at Crowcombe Court, Somerset, of which one half fell down some years ago. The other half, which leans a good deal, is about 50 ft. high, with a clean bole 8 ft. in girth.

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[1] *Sylva*, 115 (1670).

[2] Kirchner, *op. cit.* 282, says that the growth on the Riviera of seedlings in the open is rather slow, averaging 12 to 16 in. high at six years old.

At Shedfield House, near Botley, Hants, the residence of Lady Phillimore, Sir Hugh Beevor measured a tree 57 ft. by 6 ft. in 1906. Prof. Phillimore, who has kindly sent a specimen branch and a photograph, says that this tree is believed to be 120 to 200 years old, and to have been planted about the same time as a plane standing near it, which measures 15 ft. in girth at the base.

At Barton, Bury St. Edmunds, there is a tree of the horizontal variety which was 46 ft. by 3 ft. 8 in. in 1904.

On the lawn at White Knights Park, Reading, Mr. A. B. Jackson measured in 1909 a tree 65 ft. high and 6 ft. 11 in. in girth.

In Wales, at Penrhyn Castle, there is a group of very fine trees, supposed to be only about fifty years planted, and of which the tallest tree in the centre in 1906 was 65 ft. high by only 2 ft. 10 in. in girth; another was 55 ft. by 4¼ ft.; a third was 55 ft. by 3 ft. 2 in.

In Scotland I have seen no old trees, and but few young ones. A tree at Monreith raised by Sir H. Maxwell from seed gathered at Florence in 1878 was about 25 ft. high in 1906.

At Keir,[1] Perthshire, there are about forty trees of this species trained against the house, the largest of which is 29 ft. high and 21 in. in girth. A lithograph of the house made in 1858 shows that they were then about 10 ft. high.

In Ireland,[2] a tree at Kilruddery, near Bray, was 38 ft. by 5 ft. 5 in. in 1904; and another at Powerscourt was 36 ft. by 3 ft. 7 in. in 1909.

## TIMBER

The timber[3] is light brown in colour, hard, and close-grained, with very numerous fine medullary rays, and annual rings usually distinctly marked by a firm line. According to Mathieu,[4] the wood is easy to work, and gives off a penetrating agreeable odour. It is very durable, lasts indefinitely under water, and longer than oak when used for vine-props. In France and Italy it is considered excellent for furniture; and the doors of St. Peter's at Rome, which lasted from the time of Constantine to that of Pope Eugene IV., nearly 1000 years, were said to be made of cypress.[5] According to Madon[6] it yields in Cyprus wood of the first quality for building.

It has been frequently stated that the Egyptians used this wood for mummy cases,[7] but all the specimens in the Kew Museum have proved to be the wood of *Ficus Sycomorus*.

The large chests which are supposed to have been used for importing silk from the Levant in early times, and which are usually ornamented with carving, and sometimes bear Greek lettering, are believed to be made of this wood. Shakespeare, in *The Taming of the Shrew*, II. i. 353, says:

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[1] The account of these trees in *Journ. Roy. Hort. Soc.* xiv. 531 (1892), is not accurate. We are indebted to the owner, Archibald Stirling, Esq., for the particulars given above.

[2] In *Gard. Chron.* 1868, p. 1289, a tree in the Bridgetown garden, Castlemartyr, was reported to be 60 ft. high and 13 ft. in girth in 1868; but neither Henry nor I saw this tree on our visits to Castlemartyr.

[3] Gamble, *Indian Timbers*, 697 (1902).

[4] *Flore Forestière*, 523 (1897).

[5] Loudon, *Gard. Mag.* xv. 271 (1839). Cf. also *Gard. Chron.* 1843, p. 87.

[6] *Cyprus Parly. Paper*, No. 366 of 1881, Encl. No. 2. Madon considers it to have been the shittim wood of Scripture, out of which the ark of the covenant was constructed; but Canon Tristram, *Fauna and Flora of Palestine*, 293 (1884), identifies shittim wood with *Acacia seyal*, Delile.

[7] *Kew Bull.* 1909, pp. 74-6.

> In ivory coffers I have stuffed my crowns;
> In cypress chests my arras counterpoints,
> Costly apparel, tents, and canopies.

(H. J. E.)

## CUPRESSUS TORULOSA, Himalayan Cypress

*Cupressus torulosa*, Don, *Prodr. Fl. Nepal.* 55 (1825); Lambert, *Genus Pinus*, ii. 18 (1824); Loudon, *Arb. et Frut. Brit.* iv. 2478 (1838); Lawson, *Pinet. Brit.* ii. 201, t. 35 (1867); Hooker, *Fl. Brit. Ind.* v. 645 (1888); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 335 (1896); Kent, Veitch's *Man. Conif.* 233 (1900); Gamble, *Indian Timbers*, 696 (1902); Collett, *Fl. Simlensis*, 483 (1902); Brandis, *Indian Trees*, 693 (1906).

*Cupressus Tournefortii*, Tenore, in *Mem. Soc. Ital. Sc. Modena*, xv. pt. 2, p. 194 (1855) (not Audibert).

*Cupressus pendula*, Hopf, in Regel, *Gartenflora*, iii. 279 (1854) (not Thunberg).

*Cupressus majestica*, Knight and Perry, *Syn. Conif.* 20 (1850).

*Cupressus Corneyana*, Knight and Perry, *Syn. Conif.* 20 (1850).

A tree, attaining in the Himalayas 150 ft. in height and 37 ft. in girth. Bark, $\frac{1}{2}$ in. thick, brown, peeling off in long, narrow fibrous strips. Branches horizontal or ascending, with pendulous tips, forming a broad pyramidal crown. Branchlet systems alternate, distichous, two- or three-pinnate, with the pinnæ disposed more or less in one plane. Ultimate branchlets often curved, tetragonal, equal-sided, $\frac{1}{24}$ in. in diameter. Leaves[1] uniform in four ranks, closely appressed, $\frac{1}{16}$ in. long, ovate, obtuse at the apex, convex on the back, and often with an obscure longitudinal glandular depression. Older branchlets reddish brown, not glaucous, terete, with the leaves completely deciduous in the fifth year.

Staminate flowers $\frac{1}{4}$ in. long, when open, with three to four anthers on each of the twelve to sixteen stamens. Cones, when young, green variously tinged with plum colour, ripening in October and November of the second year, often persistent after the fall of the seeds for one or two years longer; when mature, on short recurved stalks, globose or ellipsoidal, $\frac{1}{2}$ in. in diameter, dark reddish brown; scales, eight to ten, with the outer surface depressed in the centre and giving off a small triangular, rounded or acute, often recurved process. Seeds, six to eight on each scale, pale brown, $\frac{1}{6}$ in. long, flattened on one surface, convex and scarcely ridged on the other, with inconspicuous resin vesicles; wing rather broad, with a narrow translucent border. Cotyledons, three to five.[2]

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[1] Hood, in *Gard. Chron.* 1847, p. 766, states that the foliage gives off a peculiar scent, noticeable on a windy day to leeward of the tree.

[2] Described by Hill and De Fraine, in *Ann. Bot.* xxii. 699 (1908).

We have not been able to distinguish, in England, var. *majestica*,[1] Carrière, *Conif.* 118 (1855); but the following variety is noteworthy:—

Var. *Corneyana*, Carrière, *Conif.* 151 (1867).

*Cupressus Corneyana*, Knight and Perry, *Syn. Conif.* 20 (1850).

*Cupressus funebris*, Koch,[2] *Dendrologie*, ii. pt. 2, p. 160 (1873) (not Endlicher).

Branches and branchlets pendulous. Branchlet systems irregularly arising at varying angles, and not so distichous as in the type, forming a more diffuse and not flattened mass of foliage. This variety was first put into commerce by Knight and Perry, who stated that: "It is not certain whence it has been introduced, but it is supposed to be a native of either Japan or the north of China," and acting on this belief they named it after Mr. Corney, a merchant in China, who occasionally sent seeds to their nursery at Chelsea; but they never affirmed that it was raised from Chinese or Japanese seed. Doubtless it originated in the Chelsea nursery, as it differs in no respect, except in habit, from the type; and *C. torulosa* is unknown in China and Japan.

## DISTRIBUTION

This beautiful tree is a native of the outer ranges of the western Himalayas, from Chamba to Nepal, between 5500 and 9000 ft. elevation. It is rather local in its distribution, and usually grows on limestone. Brandis[3] mentions several localities—small patches on the Ravi, parts of Kulu, limestone rocks of the Shali and Tika hills, near Simla;[4] limestone hills of Lokandi and Moila, and below the Karamba peak in Jaunsar; on the Chinar peak below Naini Tal, where it is found exceptionally on clay slate, but near limestone. It also grows in the Bamsu valley in Tehri-Garhwal, attaining a considerable size. Webber[5] says that it only grows on sunny slopes over 7000 ft. altitude in isolated localities, and mentions trees on the Chinar peak 150 ft. high with stems clean to near the top, the greatest girth that he measured being 37 ft. Gamble speaks of a tree at the Deota temple in the Tons valley, which is 154 ft. high and 22 ft. in girth.

This species reproduces well from seed, and seedlings are often found in the crevices of vertical precipices, as at Moila, producing trees which grow first outward and then straight up the rock. It succeeds, when planted, at low elevations, even in the plains of India, as at Calcutta, Dehra Dun, Saharanpur, and Chikalda in Berar. Young plants are often attacked by a fungus,[6] *Gymnosporangium Cunninghamianum*, which occurs as a yellow gelatinous mass. (A. H.)

## CULTIVATION

The first description of this tree was based by David Don, in 1825, on specimens collected by Buchanan-Hamilton, in Nepal, in 1802-3; and seeds were first sent to Europe by Dr. Wallich in 1824.[1] Though it has been planted at many places since that date, it has never become common in cultivation, and evidently requires, in order to succeed, a warmer climate than most parts of England afford.

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[1] *Cupressus majestica*, and also *Cupressus flagelliformis*, Knight and Perry, *Syn. Conif.* 20 (1850). A specimen of *C. majestica* cultivated at Montpellier is identical with typical *C. torulosa*.

[2] Both Gordon, *Pinet. Suppl.* 24 (1862), and Koch, *loc. cit.*, erroneously considered this variety to be the weeping cypress of China.

[3] *Forest Flora N.W. India*, 533 (1874).

[4] Collett, *Fl. Simlensis*, 483 (1902), says that it occurs at Simla, where it is known to the natives as deodar, on the road to the pumping station, and beyond the tunnel. On the north side of Mount Shali it grows at 8000 to 9000 ft.

[5] *Forests of Upper India*, 42 (1902).

[6] The alternate generation of this fungus occurs on the leaves of *Pyrus Pashia*. Cf. *Indian Forester*, xxv. 435.

Lawson quotes Palmer's tables to the effect that, in the winter of 1860-61, out of 52 specimens in England, 34 were killed, 9 much injured, 2 slightly injured, and only 7 unhurt. In Scotland and Ireland the results were very similar. Rarely, except in the south of England or near the sea, and in Ireland, where severe frosts have less effect, are trees of any size to be found.[2]

## Remarkable Trees

The largest that we know of at present is in the grounds at Killerton, where there is a fine tree of about 65 ft. by 5 ft. 4 in., which when seen in 1905 was very thriving.

There is a fine avenue of *C. torulosa* at Cuffnells, near Lyndhurst, Hants (Plate 294), which, I am informed by Mr. Hargreaves, were raised from seed brought from India by Mr. C. Harland in 1860. This avenue consists of nine trees on each side of a walk, which are very regular in habit, and measure about 45 ft. by 4½ ft. They bore fruit in October 1907.

Mr. A. B. Jackson measured several trees in a plantation at Tregothnan, about 40 to 45 ft. by 3 ft., in 1909; and two trees at Pencarrow, which are 48 ft. by 4 ft. 8 in. and 35 ft. by 4 ft. 1 in. At Heanton-Satchville, North Devon, I measured, in 1905, a tree, about 45 ft. high and 3 ft. 5 in. in girth, dividing into three stems at 10 ft. from the ground, and forming a dense pyramid of foliage. At Haldon House, Exeter, a tree, which I saw in April 1908, measured 46 ft. At Melbury there is a tall fine tree of var. *Corneyana*, bearing fruit near the summit, which was 65 ft. by 4 ft. 11 in. in 1908.

At Eastnor Castle there is a tree 39 ft. high by 3 ft. 1 in. in girth, measured by Mr. Mullins in 1909. At Hewell Grange, Redditch, there are four trees of this species, the largest of which, measured by me in 1909, was 56 ft. high by 3 ft. 11 in. in girth. It is almost fastigiate in habit. These trees are growing at 530 ft. elevation, on sloping ground, exposed to the south-west. At Woburn there is a tree about 30 ft. in height; and Mr. J. M. Rogers has sent specimens from a tree at Riverhill, near Sevenoaks, about 40 ft. high.

In Ireland, the best specimen which we have seen is at Fota, and measured 56 ft. by 7 ft. in 1908. Another at Powerscourt is 27 ft. by 3 ft. 4 in.

In the nursery of Rovelli Frères, at Pallanza, I measured in 1906 a very handsome tree, with stouter branchlets than usual, 80 ft. by 9 ft., which was bearing cones, and may be the variety described as var. *majestica.*

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[1] Wallich sent seeds again in 1836; and Loudon, in *Gard. Mag.* xvi. 586 (1840), mentions a large stock of plants at Cullis's nursery at Leamington in 1840. Considerable quantities of seed of this cypress, as well as of the deodar, were imported in 1853 from the Himalayas by the Commissioners of Woods.

[2] According to *Gard. Chron.* 1868, pp. 152, 465, plants of *C. torulosa* were killed at Dropmore and Gunnersbury Park in the severe winter of 1867-68. According to *Kew Bulletin*, 1896, p. 8, the severe frost of 26th January to 22nd February 1895, when the thermometer fell at Kew on two occasions to 1° and 2° Fahr., proved fatal to *C. torulosa* and *C. lusitanica*, while *C. sempervirens* and *C. macrocarpa* were badly injured.

### TIMBER

According to Gamble, the timber is even more durable[1] than that of the deodar, and is used for building temples and for sleepers, though not procured in sufficient quantity to have much commercial importance. The wood is also burned as incense in Hindu temples. It weighs from 34 to 44 lbs. per cubic foot. It is moderately hard and close-grained, with white sapwood, and light brown and very fragrant heartwood, which shows darker streaks. The annual rings are distinctly marked by a narrow dark-coloured belt, with resin-cells in lines near them, which are very numerous in old trees. (H. J. E.)

## CUPRESSUS CASHMERIANA

*Cupressus cashmeriana*, Royle,[2] ex Carrière, *Conif.* i. 161 (1867).
*Cupressus funebris*, Endlicher, var. *glauca*, Masters, *Kew Handlist Conif.* 37 (1896).
*Cupressus torulosa*, Don, var. *kashmiriana*, Kent, Veitch's *Man. Conif.* 234 (1900).
*Juniperi sp.*,[3] Griffith, *Itin. Notes*, 100, No. 27 (1848).

A tree, the dimensions of which in the wild state are not known, but described by Griffith as small, extremely elegant, and with smooth bark. In cultivation narrowly pyramidal, with ascending branches, and very pendulous branchlets, the bark being divided into long narrow scaly ridges.

Branchlet systems long and pendulous, alternate, distichous, two- to three-pinnate, with the pinnæ disposed more or less in one plane. Ultimate branchlets compressed, tetragonal, $\frac{1}{30}$ in. wide (not inclusive of the spreading leaves). Leaves glaucous blue, the lateral pair conduplicate, ridged on the back, the facial pair flattened with a longitudinal furrow, all four ranks about $\frac{1}{8}$ in. long, decurrent in their basal half, with lanceolate acuminate spreading apices, tipped with a fine cartilaginous point. Older branchlets reddish brown, bare of leaves in the third or fourth year.

Cones, when young, greenish yellow, with a glaucous bloom confined to the prominent spreading umbos; ripening in the second year, when they become dark brown, almost blackish, ellipsoidal, nearly $\frac{1}{2}$ in. in diameter when closed; scales ten, with a central depression and an acute triangular reflexed process. Seeds about ten on each scale, reddish or pale brown, $\frac{1}{8}$ to $\frac{1}{6}$ in., with narrow wings and scattered resin-vesicles.

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[1] Experiments were made at Dehra Dun, with sleepers of various timbers, put down in 1881 and taken up in 1892, and the cypress wood was found to have resisted best of all. Cf. *Ind. Forest.* xix. 207.

[2] We are unaware of the reason why this species is ascribed to Royle, as no mention of it can be found in his published writings.

[3] Griffith's description is as follows:—"Arbor parva elegantissima cortici lævi. Ramulis pendulis foliis senioribus ferrugineo-brunneis, junioribus glaucis. Dewangiri near the faqueer's house." This locality is in Bhutan, and specimens labelled No. 27 are preserved at Kew and Cambridge. Mr. J. Claude White in *Sikkim and Bhutan* (London, 1909), speaks of an immense weeping cypress which he saw at Chalimaphe, and which measured 50 ft. in girth. He also speaks of fine forests of cypress at 8000 to 9000 ft. in Bhutan. I supposed that these might be the same as Griffith's tree; but am informed by Mr. W. C. Smith, curator of the Herbarium at Calcutta, that he can find no specimens of cypress in Mr. White's collection, and suspects that the tree in question may be a juniper.—(H. J. E.)

This species, judging from the cones, which resemble those of *C. torulosa*, is possibly a form of that species with juvenile acicular foliage. A solitary example was seen in cultivation in Bhutan by Griffith. Hooker, who apparently did not distinguish this species from *C. funebris*, collected two specimens from cultivated trees in Sikkim. Carrière states that it was introduced into Europe from Tibet about 1862.

The only specimen which we know of in this country is the beautiful tree in the Temperate House at Kew, which is now about 30 ft. high, having recently been topped, as its summit had reached the roof.[1] It bears fruit abundantly, but no seed has been sown, and we do not know whether seedlings, if produced, would preserve the character of the parent tree. Messrs. Veitch tell us that it has not proved sufficiently hardy to be kept out of doors at Coombe Wood, and they have no plants at present. There is, however, a small tree doing well in the open air at Rostrevor House, near Newry. (A. H.)

In Italy the finest specimen is growing in front of the villa on the Isola Madre in Lake Maggiore.[2] This is one of the most beautiful conifers that I have seen anywhere, and measured in November 1906, 60 ft. high by 6 ft. in girth, and covered an area 35 paces in circumference. It bore fruit near the top of the tree. Seedlings of this lovely species can be had from the nursery of Rovelli Frères at Pallanza.

(H. J. E.)

## CUPRESSUS FUNEBRIS, Chinese Weeping Cypress

*Cupressus funebris*, Endlicher, *Syn. Conif.* 58 (1847); Planchon, in *Flore des Serres*, vi. 90 (1850); Lindley, in Paxton, *Fl. Gard.* i. 47 (1850); Hooker, *Fl. Brit. Ind.* v. 646 (1888); Masters in *Journ. Linn. Soc.* (*Bot.*) xxxi. 337 (1896), and xxvi. 540 (1902); Franchet, in *Journ. de Bot.* xiii. 263 (1899); Kent, Veitch's *Man. Conif.* 203 (1900); Diels, *Flora von Central-China*, 219 (1901); Brandis, *Indian Trees*, 694 (1906).

*Cupressus pendula*, Staunton,[3] *Embassy to China of Earl Macartney*, ii. 525, pl. 41 (1798) (not Thunberg[4]); Lambert, *Genus Pinus*, ii. 124, t. 66 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2479 (1838); Griffith, *Itin. Notes*, 131, 143 (1848).

*Cupressus amœna*, Koch, in *Monatssch. Garten- u. Pflanzekunde*, i. 110 (1873), and *Dendrologie*, ii. pt. 2, p. 164 (1873).

A tree, attaining in China 70 ft. in height and 2 ft. in diameter. Bark brown, smooth. Branches ascending and horizontal, ending in long pendulous reddish brown terete slender branchlets. Branchlet systems alternate, distichous, bipinnate, with the pinnæ more or less in one plane. Ultimate branchlets compressed, $\frac{1}{20}$ in. wide, $\frac{1}{50}$ in. thick. Leaves of two kinds; lateral pairs conduplicate; facial pairs flattened, ovate, keeled or with a median furrow; all appressed, but with the mucronate apex free and slightly spreading, greyish green, not marked by whitish lines or streaks, about $\frac{1}{12}$ in. long.

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[1] This tree was presented to Kew in 1894 by Mrs. Forster, Homewood, Chislehurst, who informs us that she had received it from the Rev. F. Murray, formerly Rector of Chislehurst. Its origin is unknown.

[2] Cf. Beissner in *Mitt. deut. dend. Ges.* 1906, p. 98.

[3] Staunton's specimen, on which Lambert founded his description of this species, is preserved in the British Museum. It is identical with specimens collected by Fortune and by myself in China, and was collected near Lake Sihoo in Chekiang. The plate represents a view of the lake with a very pendulous cypress in the foreground, much more weeping in habit than any trees we have seen.

[4] *Cupressus pendula*, Thunberg, *Fl. Jap.* 265 (1784), is *Thuya orientalis*, L., var. *pendula*, Masters.

Staminate flowers yellow, $\frac{1}{10}$ in. long; stamens about 8. Cones globose, $\frac{1}{3}$ to $\frac{1}{2}$ in. in diameter, on long slender often curved stalks, ripening in the second year and falling soon afterwards, dark brown covered with a plum-coloured bloom; scales eight, scarcely depressed in the centre from which arises a minute ovate usually appressed process. Seeds three to five on each scale, $\frac{1}{8}$ in., shining reddish brown, with scattered resin-vesicles and narrow wings. Cotyledons two.

This species is a native of central China, occurring in mountainous districts, at elevations usually below 3000 ft., in the provinces of Szechwan, Hupeh, Anhui, and Chekiang. It was discovered by Sir George Staunton, who was Secretary to Lord Macartney's embassy to China in 1793, in the Vale of Tombs,[1] near Lake Sihoo, in the Hangchow prefecture of Chekiang, where it was planted in quantity around the graves. Fortune[2] in 1848 found it common in the green tea district of Huichou in Anhui, growing in clumps on the sides of the hills, generally near villages or amongst graves. He afterwards saw it in great abundance in the mountains south-west of Ningpo, and at Nanche and Yenchou in the Chekiang province. Fortune also noticed it in cultivation at Shanghai.

It is common in the neighbourhood of Ichang, close to the Yangtze, in the centre of China, where I found it in 1884. Here it grows in valleys, often forming pure woods of considerable extent, which are the home of the Reeves' pheasant in this district.

According to Wilson,[3] it is common from Ichang westward both in the immediate vicinity of the great river, and in the mountains north and south of it up to 3000 ft. altitude. He noticed it particularly in the Yangtze gorges between the Hsinlung rapid and Wanhsien. Here the temperature sometimes falls in winter below freezing point, and there are occasional heavy falls of snow, but the climate is excessively hot in summer, and wherever this cypress grows wild the orange can be cultivated to perfection. In Szechwan it was collected by Père Farges[4] at 4000 ft. elevation in the Chengkou district, and by von Rosthorn in the Nanchwan district. Wilson describes its great utility for boat-building at Wanhsien. With the exception of a few cross-beams of oak, the river boats are built entirely of the timber of *C. funebris*. The wood is close-grained, and is much used in central and western China for house-building and general carpentry.

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[1] This locality is erroneously stated by Lindley in *Gard. Chron.* 1849, p. 243, and by Kent, to be in northern China, where the tree is unknown, as the climate in winter is much too severe. The distribution as given by Masters in *Journ. Linn. Soc.* (*Bot.*) xxxviii. 202 (1908), also erroneously includes northern China and is much too extensive.

[2] Fortune, in *Gard. Chron.* 1850, p. 228, gives an account of his discovery of this tree. Cf. also his *Tea Countries*, 16, 61, 64, 107, 314, and fig. on p. 63 (1852), and *Residence among the Chinese*, 145, 177 (1857).

[3] In *Gard. Chron.* xxxviii. 94 (1905).

[4] Franchet, in *Journ. de Bot.* xiii. 263 (1899).

The tree, which has been known to the Chinese as *poh* or *peh* from the earliest times, was planted[1] by the founder of the Yin dynasty about the altars of the spirits of the land. In the *Ch'un Ts'iu Wei* (100 B.C.), the cypress was directed to be planted around the tumuli, where feudal princes were buried, the pine being reserved for the tombs of the emperors; while Koelreuteria and Sophora were planted around the graves of officials of various degrees, only the willow being allowed in the case of the common people.

This species is cultivated in the eastern Himalayas, in Nepal, Sikkim, and Bhutan,[2] at 4000 to 8000 ft., chiefly near temples and monasteries, and no doubt it was early introduced from western China by the Buddhist monks. Sir J. Hooker[3] measured a tree in a temple at Doobdi, probably the oldest specimen in Sikkim, at 6470 ft. elevation, apparently 90 ft. high, and with a girth of 16½ ft. at 5 ft. from the ground. This tree was not pyramidal, as all the young trees were, but had spreading branches, those at the top being dead and broken.

According to Gamble[4] it is a fine species, easy to grow, and in the Dhobijhora plantation near Kurseong, trees planted in 1866 had attained in 1899 a girth of over 4 ft. There are several specimens about Darjeeling, and a remarkably fine tree at the Tasingthong Monastery in British Bhutan.

The wood is moderately hard, close and even in the grain, light yellow, with the annual rays only visible in young trees, but with concentric bands of lighter and darker tissue. The medullary rays are very fine, close, and numerous. There are occasional resin-ducts and resin-cells.

Lambert thought that this species was introduced from south China by W. Kerr in 1804; but Loudon says "supposed to have been introduced in 1808, but respecting which we know nothing with certainty," and was in doubt as to whether a pendulous cypress at Chiswick, and another growing in the Kew Arboretum in 1838, were this species.[5] Fortune[6] sent cones to Standish in 1848, from which plants were raised at Bagshot. A further supply of seed was also forwarded from Huichou by Fortune in 1853. All the seedlings planted out at Kew[5] were soon killed; and this species is not hardy,[7] except in the south-west of England and in Ireland.

(A. H.)

This tree is rarely seen except in the south and west,[8] and is too delicate to stand out of doors in the colder parts of Britain. There are specimens in the temperate house at Kew.

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[1] Bretschneider, *Bot. Sinicum*, ii. 336, 381 (1892). The name *poh* is also given to *Thuya orientalis*, *Juniperus chinensis*, and *Libocedrus macrolepis*.

[2] Griffith, *Itin. Notes*, 131, 143, found this tree in Bhutan at 6400 ft. often attaining 80 ft. in height. Anderson, in Eden, *Political Missions to Bootan*, Botany, 135 (1865), says it is cultivated much more frequently in Bhutan than in Sikkim, and at lower elevations, down to 2000 ft., while in Sikkim it is never found lower than 5000 ft.

[3] *Himalayan Journals*, i. 316, 317, 336, fig. on 337 (1854).

[4] *Indian Timbers*, 697 (1902).

[5] J. Smith, *Records of Kew Gardens*, 290 (1880), says that a plant at Kew, 9 ft. high in 1864, and known as the "weeping cypress of China," was perfectly hardy, and had been introduced prior to Fortune's time. This is no longer living, and doubtless was a pendulous variety of *Thuya orientalis*.

[6] Cf. Lindley, in *Gard. Chron.* 1849, p. 243, where it is erroneously stated that Fortune obtained the cones from a place 200 miles north of Shanghai. We have to understand here south-west of Shanghai, as Fortune collected this seed at Huichou, in Anhui. The most northerly point ever reached by Fortune was Soochow, lat. 31° 19′.

[7] It is frequently seen in conservatories as a handsome pot plant, with slightly glaucous, juvenile acicular foliage. Some of the branchlets, however, usually display adult leaves of the normal form, and occasionally bear cones. This juvenile form is readily propagated by cuttings, and is often considered to be a juniper.

[8] A tree in the park at Bath stood uninjured for twenty years, and was 20 ft. high in 1880 (*Gard. Chron.* xiv. 503 (1880)). It has succumbed since. At Linton, Kent, a tree was reported to be 16 ft. high in the same year.

At Haldon House, Exeter, there is a fine tree, 50 ft. by 6 ft. in 1908.

At Tortworth there is a healthy tree, about 35 ft. high in 1909, the origin of which, according to Lord Ducie, is unknown.

Trees about 30 ft. to 35 ft. high have also been observed at Killerton,[1] near Exeter; at Lamellan, Heligan, and Penjerrick in Cornwall; and at Osborne, Isle of Wight.

In Ireland, a tree at Powerscourt was found by Henry to be 30 ft. by 2 ft. 7 in. in 1906. There are also trees at Kilmacurragh and at Castlemartyr, which I saw in July 1908. (H. J. E.)

## CUPRESSUS MACROCARPA, MONTEREY CYPRESS

*Cupressus macrocarpa*, Hartweg, in *Journ. Hort. Soc.* ii. 187 (1847); Gordon, in *Journ. Hort. Soc.* iv. 296 (1849); Lawson, *Pinet. Brit.* ii. 195, t. 32 (1884); Engelmann, in Brewer and Watson, *Bot. Califor.* ii. 113 (1880); J. D. Hooker, in *Gard. Chron.* xxiii. 176, fig. 34 (1885); Sargent, in *Garden and Forest*, vii. 241 (1894), *Silva N. Amer.* x. 103, t. 525 (1896), and *Trees N. Amer.* 77 (1905); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 342 (1896); Kent, Veitch's *Man. Conif.* 215 (1900); Mayr, *Fremdl. Wald- u. Parkbäume*, 286 (1906); Jepson, *Flora Calif.* 60 (1909).

*Cupressus Lambertiana*, Carrière, *Conif.* 124 (1855), and in *Rev. Hort.* 1855, p. 232.

*Cupressus Hartwegii*, Carrière, in *Rev. Hort.* 1855, p. 232, and *Conif.* 168 (1867).

*Cupressus guadalupensis*, S. Watson, in *Proc. Am. Acad.* xiv. 300 (1879).

*Cupressus torulosa*, Lindley, in Paxton, *Flower Garden*, i. 167, fig. 105 (1850), and in *Flore des Serres*, vii. 192 (1851) (not Don).

*Cupressus Reinwardtii*, Beissner, *Nadelholzkunde*, 103 (1891).

A tree, attaining at Monterey 70 ft. in height and 20 ft. in girth. Bark, about an inch thick, irregularly divided into broad flat connected ridges, separating on the surface into narrow elongated thick persistent scales, dark reddish brown on young stems, almost white on old and exposed trunks.

Branchlet systems alternate, spreading at various angles upwards and outwards, bi-pinnate, with the pinnæ not in one plane. Ultimate branchlets tetragonal, equal-sided, $\frac{1}{20}$ in. in diameter. Leaves[2] uniform in four rows, appressed, $\frac{1}{16}$ in. long, ovate, obtuse at the apex, convex from side to side and swollen towards the tip, occasionally with a linear longitudinal furrow.

Staminate flowers yellow, $\frac{1}{8}$ in. long; stamens, six to eight, each with an ovate connective bearing four or five dark-coloured anther cells. Pistillate flowers brownish, with reflexed thin-edged scales. Cones in the first year with prominent pyramidate scales, tipped with a mucro; ripening at the end of the second year, and persistent for many years afterwards on the branchlets; when mature, on stout, reddish brown scaly stalks, ellipsoidal, 1 in. to $1\frac{1}{2}$ in. long, $\frac{3}{4}$ in. broad, shining reddish brown; scales usually ten, occasionally eight, twelve, or fourteen, with a central depression, overhung by an arcuate ridge-like thin-edged process. Seeds, about twenty on each scale, $\frac{1}{6}$ in. long, ridged, convex or angled on the two surfaces, which are marked with minute vesicles; wings broad, with a narrow, translucent border. Cotyledons,[1] three or four.

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[1] Cultivated as *C. sinensis*.

[2] The foliage when rubbed emits an agreeable odour, resembling that of lemon.

### VARIETIES

In the wild state at Monterey, this species shows no variation, except the marked difference in habit due to age, young trees being narrowly pyramidal, while old trees assume a broad and flattened crown, resembling Lebanon cedars in their general appearance.

1. Var. *guadalupensis*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 343 (1896).

*Cupressus guadalupensis*, Watson, in *Proc. Amer. Acad.* xiv. 300 (1879), and Engelmann, in Brewer and Watson, *Bot. Calif.* ii. 114 (1880).

This variety, growing on Guadalupe Island, differs slightly in the glaucous leaves and globose cones. Specimens of this variety growing at Montpellier show more slender branchlets and smaller leaves than typical *C. macrocarpa*. The foliage has a bluish tint. A young plant in the Temperate House at Kew is similar, but green in colour.

Under cultivation, the Monterey tree tends to assume two distinct habits, which are, however, connected by intermediate forms. Both have been found as seedlings in beds raised from the seeds of a single tree:—

2. Var. *fastigiata*,[2] Masters, *loc. cit.* Branches fastigiate; tree narrowly pyramidal in form.

3. Var. *Lambertiana*,[3] Masters, *loc. cit.* Branches spreading, the tree resembling when old a Lebanon cedar.

The following varieties[4] have also arisen in the seed-bed:—

4. Var. *Crippsii*, Gordon, *Pinetum*, 93 (1875). A plumose or juvenile form, with short rigid branches, and leaves not appressed, but more or less spreading and sharp-pointed. This variety was raised in Cripps' nursery at Tunbridge Wells from an imported seed.

5. Var. *lutea*, Kent, Veitch's *Man. Coniferæ*, 215 (1900). Young shoots light yellow, turning green in the second year. Earl Annesley, *Beautiful Trees*, 57 (1903), figures this variety 21 ft. high, planted eight or nine years previously; and states that it is fastigiate in habit, strikes easily from cuttings, and preserves its colour.

6. Var. *variegata*.[5] Young branchlets irregularly blotched with white.

7. Var. *farallonensis*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 344 (1896). A peculiar form reported to exist on the Farallones Islands, near San Francisco.

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[1] Described by Hill and De Fraine, in *Ann. Bot.* xxii. 702 (1908).

[2] Carrière states that the fastigiate form is much less hardy than the other. This must have been an accidental peculiarity in a few trees noted by him.

[3] This form is said to be obtained artificially by topping off the leading shoots of ordinary seedlings. The tops, if treated as cuttings and struck, assume also the flat-headed form. Such trees, obtained from cuttings, are said to be superior, when this species is used for a hedge or wind-break. Cf. *Gard. Chron.* xxvii. 44 (1900).

[4] In *Gard. Chron.* 1872, p. 609, Messrs. Garroway, of Bristol, are said to have raised from seed a dwarf variety, 4 in. high at nine years old.

[5] Lemaire, *Illust. Hort.* t. 587 (1869), and *Gard. Chron.* 1869, p. 1036.

Mr. Jepson writes to me that these islands are barren rocks without any woody vegetation. The specimens ascribed to this variety appear to be a form with glaucous foliage, which arose as a sport in the California University garden, and is unknown in cultivation in England.

## DISTRIBUTION

This tree has a very restricted range[1] in the wild state, as it only occurs near Monterey in California, and on the island of Guadalupe, off the coast of Lower California. At Monterey, the main grove occupies an area along the sea-coast about two miles long and 200 yards wide, from Cypress Point to the shores of Carmel Bay. A smaller grove occurs on Point Lobos, the southern boundary of the bay. In this narrow area, which extends from the sea-cliffs inland to where the cypress begins to mingle with *Pinus radiata*, the trees are of different ages and appearance. When young and crowded, they have tall stems and narrow pyramidal crowns; older trees tend to stand wide apart and have flattened crowns, with far-spreading and gnarled stout branches. Plate 295 shows how different is the appearance of mature trees at Monterey from the young specimens which we see in this country.

Many of the trees at Monterey[2] are exposed to constant strong winds from the sea, which often prevent the development of branches on the windward side of the trunk, and cause many of the stems to lie almost prostrate on the ground. Near Monterey this cypress, in conjunction with *Pinus radiata*, is planted on the sand-dunes down to the margin of the breakers, so that the trees are often bathed in salt water, thrown up by large waves at high tide. Frost is almost unknown at Monterey,[3] yet *C. macrocarpa* is cultivated on the Pacific coast, as far north as Oregon and Washington, where the winters are cold; and Mayr states that it thrives at Tokyo, where the thermometer often falls to 14° Fahr.

On the island of Guadalupe, this cypress is almost confined to the high central plateau, where it covers an area of two or three square miles. It is said by Dr. Franceschi[4] to be very variable both in habit and in the size, shape, and colour of the cones. (A. H.)

## CULTIVATION

This species[5] was cultivated in the Horticultural Society's Garden at Chiswick in 1838, from seeds of unknown origin presented by Lambert. Two or three years afterwards plants were noticed in Low's nursery at Clapton, which had been raised from seed received from Fischer, Director of the St. Petersburg Botanic Garden, as a new species of cypress from California. Hartweg found the tree near Monterey in 1846, and sent home a further supply of seed.

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[1] Cf. Sargent, in *Garden and Forest*, vii. 241, fig. 41 (1894), where the trees at Cypress Point are described and figured. Two photographs of the Monterey grove are also reproduced in *Gard. Chron.* xxii. 52, figs. 17, 18 (1897). Cf. also *The Garden*, xxx. 189, *cum fig.* (1886).

[2] Hickman, in *Erythea*, iv. 195 (1896), describes a miniature forest of this species at Monterey, consisting of trees scarcely a foot in height, yet bearing clusters of ripe fruit. In all probability these trees are *C. Goveniana*.

[3] The climate at Monterey is described in our article on *Pinus radiata*, p. 1081.

[4] *Zoe*, iv. 138 (1893).

[5] Cf. Gordon, in *Journ. Hort. Soc.* iv. 296 (1849), and A. Murray, in *Garden*, i. 330 (1872). The date is wrongly given as 1831 by Kent, in Veitch's *Manual*.

Though the natural habitat of this tree is in a region where frost rarely occurs, yet its constitution is so robust that it thrives on dry soil in many inland districts where the thermometer descends to zero, and in the warmer and moister counties of the south and west has already attained as great a height as any recorded in its native country; but it cannot be called hardy[1] everywhere, as it is on heavy or wet soil liable to be severely cut by frost in winter and spring, especially in low-lying situations.

Its power of resisting strong gales from the sea, and its partiality for a maritime climate, make it a valuable tree for planting where shelter belts are required on the coast; and its rapid growth when young, coupled with its bushy habit, are additional points in its favour for this purpose.

Lawson's *Pinetum Britanicum* gives many particulars of its comparative hardiness in various parts of the country, and quotes statistics from Palmer's tables showing that in the severe winter of 1860-61 it was killed in 57 places, injured in 24, and unhurt in 27. Of the latter all those in the north are near the sea, but even as far north as the Orkney Islands it was said by Mr. Macdonald,[2] gardener at Balfour Castle, to be the most valuable of all the conifers, enduring the storms and saline winds without any signs of injury.

It seems indifferent to the nature of the soil in a well-drained situation, and grows well on limestone, sand, and peat.

It produces seed freely in this country, and is easy to raise from seed, growing faster when young than any other cypress, and attaining 6 to 10 in. in the first year's growth. It transplants without much risk in the spring or early autumn, and can be raised so cheaply and rapidly that there is every inducement to plant it more freely than has hitherto been done as an ornamental tree. But its timber seems to be so coarse and knotty as compared with that of other cypresses, that it is not likely to be of any economic value.

In habit it varies very much, and it is possible that by selection of seed from trees showing an upright and fastigiate habit, varieties may be fixed in cultivation, which do not produce branches so freely as those commonly seen.

This cypress is one of the most valuable species for making hedges, good examples of which may be seen at Torquay.[3] It bears clipping well, grows very fast, much faster than yew, and is of a lively green colour. It is said to be rarely attacked by rabbits,[4] but I cannot say this from personal experience.

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[1] According to *Gard. Chron.* 1868, p. 152, a tree planted at Gunnersbury Park in 1854, and which had attained 61 ft. in height, was destroyed by the severe frost of the winter 1867-68. In *Gard. Chron.* 1870, p. 249, it is stated that nearly all the specimens in the Thames valley were killed in 1860. This species was badly injured at Kew by the severe frost of February 1895. Cf. *Kew Bulletin*, 1896, p. 8.

[2] *Journ. Roy. Hort. Soc.* xiv. 526 (1892).

[3] Cf. *Gard. Chron.* xxvi. 342 (1899). A hedge of this species, 10 ft. high and 400 yds. long, at Lofthouse, Torquay, which was planted in 1892, is illustrated in *The Garden*, lxvii. 358 (1905).

[4] A. Gooden, in *Gard. Chron.* xxvi. 466 (1904), reports that four bullocks were killed at Burton Park, Petworth, it was supposed, through eating *C. macrocarpa*, but this is unconfirmed.

### Remarkable Trees

Perhaps the largest tree[1] that I know of in England grows on an open hillside at Lamorran, on Lord Falmouth's property in Cornwall, and this in 1905 I found to be 86 ft. by 12½ ft. At the same place in a wilderness, which was once the garden of the late Hon. Rev. T. Boscawen, there are several trees almost if not quite as tall, with boles 8 to 9 ft. in girth, clear of branches up to about 20 ft.

At Enys, the seat of J. D. Enys, Esq., in the same county, there is a tree 80 ft. by 11 ft. 5 in., which he considered the finest in Cornwall; and at Carclew there is another 84 ft. by 11½ ft., which, however, has increased but little since 1891, when it was reported under the name of *C. Lambertiana* as 82 ft. high, and then the largest in England.[2] At Luscombe Castle there is a fine tree which Mr. Seaborne measured as 91 ft. by 14 ft. 2 in. in 1909. At Penrose, near Helston, a tree planted thirty-five years previously measured[3] in 1894 80 ft. in height and 19 ft. in girth at 4 ft. from the ground, dividing above into six stems.

At Beauport, Sir A. Lamb showed me in 1905 a number of fine trees varying extremely in habit, of which Plate 296 shows one growing near his Araucaria grove, which spreads very widely and branches near the ground. At 3 ft. it is no less than 17 ft. in girth and about 64 ft. high. Another in an open part of the park is about 65 ft. by 14 ft., and of such an extremely dense bushy habit that a litter of fox cubs were bred in it at some distance from the ground. A third tree below the stables has a narrow fastigiate habit, quite different from the others, and measures about 70 ft. by 9½ ft.

At Coolhurst near Horsham there is a fine timber-like tree about 70 ft. high by only 5 ft. in girth. Sir H. Maxwell has sent us a photograph of a tree at Wakehurst Place, Haywards Heath, which measured in 1907 70 ft. high and 9 ft. 8 in. in girth at 3 ft. from the ground.

At Brickendon Grange, Herts, which is 365 ft. above sea-level, with considerable cold in winter, yet little spring frost, there are numerous trees in an avenue averaging 65 ft. high and 5 ft. 2 in. in girth. Mr. Trotter, who presented a plank to the museum at Cambridge, considers the timber excellent, being very durable and strong, suitable for making wheelbarrows, carts, and rafters and beams in buildings; used for rails and posts in a fence, it has remained perfectly sound for fifteen years.

At Youngsbury, Ware, Herts, a tree planted in 1866 was 67 ft. by 8½ ft. in 1907. At Cobham, Kent, a tree measured in 1906 71 ft. by 9 ft. At Wexham Place, Stoke Poges, Bucks, there is a remarkable narrowly pyramidal tree, closely resembling the fastigiate Mediterranean cypress in habit, which Mr. R. Woodward found to be 71 ft. in height and 5 ft. in girth.

At the Butlands, Burghley Park, Stamford, there is a fine specimen growing in a plantation, 75 ft. in height and 12 ft. 7 in. in girth at 3 ft. up, dividing above into three stems. At Wimpole, Cambridgeshire, a tree measured 68 ft. by 7 ft. 8 in. in 1909. At Fulmodestone, Norfolk, a tree planted in 1861 measured in 1903, according to Sir Hugh Beevor, 68 ft. by 6½ ft. At Orwell Park, on the coast of Suffolk, *C. macrocarpa* grows well, and is quite hardy, several trees being about 70 ft. high. In Northumberland, at Twizell, there is a good-sized tree of spreading habit.

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[1] Mr. H. Clinton-Baker made this tree 88 ft. by 13 ft. in 1909.

[2] *Journ. Roy. Hort. Soc.* xiv. 488 (1892).

[3] *Gard. Chron.* xvi. 658 (1894).

Of the flat-topped and spreading variety *Lambertiana*, the best I have seen in England, is on the lawn at Cuffnells, near Lyndhurst, which in 1907 measured 75 ft. by 10 ft.; but this is not so typical as trees of much smaller size at Killerton, and at Coldrenick in Cornwall, the latter measuring in 1908 about 55 ft. by 7 ft., whilst a tree of the fastigiate type growing close to it was about 70 ft. by 8 ft. In *Pinetum Britannicum* there is a coloured plate of a tree of this type, planted at Osborne in August 1846 by the Prince Consort, which in 1865 was of very regular and perfect shape, and 40 ft. high. Col. Kilkelly informs me that it now measures 78 ft., with a girth of 16 ft. at 3 ft. from the ground. It is perhaps the finest tree of its type in England. (Plate 298.)

In Wales this tree is quite at home all round the coast, the largest I have seen being a fine and spreading tree at Bodorgan, in Anglesea, which in 1906 was about 80 ft. by 11 ft. 4 in. At Stackpole Court there is a tree 72 ft. by 8½ ft.; but I have not noticed large trees anywhere in the interior of Wales, or in the English counties on the borders of Wales, where most conifers grow so well.

In Scotland it seems to thrive best in the south-west. The most remarkable tree I have seen is in the park at Poltalloch, which has the habit of a spreading Lebanon cedar, with small but very persistent cones. It measured in 1906 about 50 ft. by 11 ft. 9 in. Mr. Austin Mackenzie reports a considerable number of specimens at Carradale, Argyllshire, mostly flat-topped and like a Lebanon cedar in habit. The largest in 1906 was 50 ft. high and 9½ ft. in girth.

In Bute, on the Marquis of Bute's property, Mr. Kay reported in 1892 a splendid vigorous tree 57 ft. by 5 ft. 8 in., but I did not see it when I visited this place in 1906.

At Castle Kennedy large numbers were planted, and Mr. Fowler's account of this species in Lawson's *Pinetum Britannicum*, vol. ii. p. 197, is worth reading; but though it grows vigorously and has ripened seeds for many years, the soil is apparently too poor, or the exposure too great here to allow the tree to attain large dimensions, as I saw none worth measuring in 1906.

It is absent from all the Perthshire lists sent to the Conifer Conference, except that from Keir, where a tree was reported as 47 ft. by 4 ft. in 1891; and I saw a tree at Murthly which was nearly killed by the severe winter of 1895-96 when the thermometer went below zero. Though it survived some severe winters at Durris and Gordon Castle, we have seen no tree of any size in other parts of Scotland.

In Ireland the Monterey cypress is at home in most parts, and there are numerous natural seedlings at Derreen in Kerry.

At Castlemartyr, Co. Cork, a tree measured in 1907 70 ft. by 9 ft. The finest tree, however, appears to be growing in a garden between Wicklow and Rathnew, which Mr. A. C. Forbes found in 1908 to be 85 ft. in height and 14 ft. 3 in. in girth. At Hamwood, Co. Meath, there is also a splendid specimen, with a tall upright clean stem, which was planted in 1844, and measured in 1903 85 ft. by 10$\frac{1}{2}$ ft. There are fine specimens at Castlewellan,[1] Powerscourt, and Fota.

At Tykillen, Co. Wexford, the seat of Captain J. Walker, there is a large spreading tree (Plate 297) about 60 ft. by 11 ft., the branches covering an area 74 paces round; and at Adare, Co. Limerick, the seat of the Earl of Dunraven, there is another very densely branched and spreading tree of about the same dimensions. Mr. Bowles, the gardener here, told me that its seedlings did not preserve the habit of the parent tree, a circumstance which had been previously referred to in *Pinetum Britannicum*, ii. 196. (H. J. E.)

## CUPRESSUS GOVENIANA, Gowen's Cypress

*Cupressus Goveniana*,[2] Gordon, in *Journ. Hort. Soc.* iv. 295, *cum fig.* (1849); Engelmann, in Brewer and Watson, *Bot. Califor.* ii. 114 (1880); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 346 (1896); Sargent, *Silva N. Amer.* x. 107, t. 527 (1896), and *Trees N. Amer.* 79 (1905); Kent, Veitch's *Man. Conif.* 204 (1900).

*Cupressus californica*, Carrière, *Conif.* 127 (1855).

*Cupressus attenuata*, Gordon, *Pinetum*, 57 (1858).

*Cupressus Sargentii*, Jepson, *Flora Calif.* 61 (1909).

A tree attaining in California a maximum of 50 ft. in height and 2 ft. in diameter, usually considerably smaller, and often a small shrub. Bark about an inch thick, dark reddish brown, irregularly divided into narrow ridges, covered with thin persistent oblong scales. Small branches reddish brown, terete, and giving off alternate branchlet systems, which are tri-pinnate, short, with the pinnæ at varying angles and not in one plane; ultimate branchlets tetragonal, equal-sided, $\frac{1}{24}$ in. in diameter. Leaves in four equal ranks, $\frac{1}{24}$ to $\frac{1}{20}$ in. long, ovate, appressed, acute and often mucronate at the apex, convex on the back, which is occasionally marked with a longitudinal depression.

Staminate flowers, $\frac{1}{8}$ in. long, yellow. Cones ripening in the second season, and persistent for several years, on long stout stalks, globose, $\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter, dark purplish brown, shining; scales usually eight, occasionally six or ten, smooth, projecting and not depressed in the centre, which bears a prominent triangular, mucronate or rounded process. Seeds, ten to twelve on each scale, variable in size and colour, either (*a*) large, $\frac{1}{8}$ to $\frac{1}{6}$ in., brown, shining, marked with resin-vesicles on both sides, and with very narrow wings; or (*b*) small, $\frac{1}{10}$ to $\frac{1}{8}$ in., blackish.

Both in wild and cultivated specimens two forms of this species are readily distinguished: (*a*) the typical form described above, characterised by coarse branchlets and short branchlet systems, which give a rigid habit to the tree; and (*b*) the following variety:—

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[1] Figured in *Flora and Sylva*, ii. 215 (1904), and in Earl Annesley, *Beautiful Trees*, 42 (1903).

[2] *Cupressus cornuta*, Carrière, in *Rev. Hort.* 1866, p. 250, fig. 32, with very irregular fruit, the upper scales of which bear long thick conical processes, described from a plant cultivated in the garden of M. Denis at Hyères, was considered by Carrière, *Conif.* 171 (1867), to be an abnormal variety of *C. goveniana*. We have not seen this plant.

1. Var. *attenuata*, Carrière, *Conif.* 172 (1867).

*Cupressus attenuata*,[1] Gordon, *Pinetum*, 57 (1858).

Characterised by looser branching, with longer branchlet systems, and very slender ultimate branchlets, about $\frac{1}{30}$ in. in diameter. Leaves $\frac{1}{25}$ in., swollen towards the apex, which is tipped with a minute mucro. Two kinds of seed are produced, as in the typical form. This variety is said by Gordon to have been introduced by French collectors; but as seen in cultivation, it appears to be a seminal variety, and is commoner than the type.

2. Var. *pendula*.

*Cupressus californica*, Carrière, *Conif.* 127 (1855).

A shrub, pendulous in habit, with long and slender drooping branchlet systems, some of the branchlets being covered with spreading sharp-pointed leaves. This appears to be a transition form between the seedling and adult stages. A plant of this variety, cultivated under the name *C. californica*, Carrière, is growing in M. Allard's arboretum at Angers; and another specimen occurs at Kilmacurragh in Co. Wicklow.

The following is considered by Sargent to be a distinct species, but, so far as we can judge, the variation in the seed is sporadic, and depends upon unknown conditions, which should be studied in the field.

3. Var. *pygmæa*, Lemmon, *W. Amer. Cone-bearers*, 77 (1905).

*Cupressus pygmæa*, Sargent, in *Bot. Gaz.* xxxi. 239 (1901), *Silva. N. Amer.* xiv. 95, t. 740 (1902), and *Trees N. Amer.* 79 (1905); Eastwood, *Trees of California*, 18 (1905).
*Cupressus Goveniana*, Jepson, *Flora Calif.* 60 (1909) (not Gordon).

A name given to trees bearing cones with small blackish seeds. This variety is prevalent near Monterey; and occupies a narrow belt in Mendocino County, California, beginning three-quarters of a mile from the ocean, and extending inland for about four miles from Ten Mile Run in the north to Navarro in the south. It is said to remain shrubby as a rule, producing fruit when only one or two feet high,[2] and grows commonly on poor soil, consisting of yellow clay covered with sand or peat; but it is admitted by Miss Eastwood to attain on good soil 30 or 40 ft. in height at fifty years old.

The typical form of *C. Goveniana* is rare and local,—apparently uncommon in the coast region of California, though it was found by Hartweg[3] at Monterey,—and usually grows on dry mountain slopes, ascending in the cañons of the mountain ranges of the central part of the state to nearly 3000 ft. Jepson,[4] who says it is a shrub or small tree, 6 to 15 ft. high, gives as localities the Mayacamas Range, Mt. Tamalpais in Marin County, Cedar Mountain in Alameda County, and one or two stations in the Santa Cruz and Santa Lucia Mountains. According to Mayr,[1] it becomes a mere shrub on hot rocky precipices, but attains 50 ft. high on the banks of streams. (A. H.)

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[1] Erroneously identified with *C. Lawsoniana* by Masters in *Journ. Linn. Soc.* (*Bot.*) xxxi. 353 (1896).

[2] Cf. p. 1167, note 2.

[3] Hartweg's specimen, No. 1971, in the Kew Herbarium, collected at Monterey, has large brown seeds, and is the type on which Gordon, who states that the seeds are brown, founded his description. Jepson, in *Flora California*, 60, 61 (1909) erroneously considers the form with small black seeds to be typical *C. Goveniana*; and on this account invents a new name, *C. Sargenti*, for the true *C. Goveniana* with large brown seeds. Both forms occur at Monterey, as Hartweg's specimen, No. 1979, preserved at the Cambridge Herbarium, was collected there and bears cones with small black seeds.

[4] *Flor. W. Mid. Calif.* 25 (1901).

This species was discovered[2] in 1846, growing near Monterey in company with *Pinus muricata*, by Hartweg, who sent home seeds to the Horticultural Society, from which plants were raised in the Chiswick Garden. It was named in compliment to J. R. Gowen, secretary of this Society at the time. It appears to be short-lived in this country, and has never become a popular or common tree; and is not now often to be found in nurseries.

The finest specimens we have seen are both on the property of J. B. Fortescue, Esq., one at Boconnoc in Cornwall, which measures 43 ft. high by 6 ft. 8 in. in girth, nearly as large as it grows in California; the other, at Dropmore (Plate 299), is 36 ft. by 5 ft. 6 in. Both of these are healthy and produce cones freely. At Luscombe Castle there is a good tree about 50 ft. by 4 ft. 4 in.

At Pencarrow, Cornwall, Mr. A. B. Jackson in 1909 measured a tree 38 ft. high and 9½ ft. in girth. Another at Heligan is 37 ft. by 3 ft. 4 in.

At Barton, near Bury St. Edmunds, Henry measured a tree in 1905 38 ft. by 2 ft. 6 in., which, according to Bunbury,[3] was planted in 1862. It is now decaying. A healthy tree at Melbury, Dorchester, is 47 ft. by 4 ft.

A tree at Tortworth is 40 ft. high and 5 ft. 1 in. in girth. The Earl of Ducie informs us that the date of planting is uncertain, but it was recorded as 12½ ft. high in 1855. It seems to be failing, but may live a few years longer. Several plants have been raised from its seed. It withstood without injury the severe frosts of 1860 and 1895.

At Eastnor Castle a tree measured in 1909 37½ ft. high, girthing at 2 ft. from the ground 3 ft. 2 in. A tree in the Victoria Park, Bath, measured in 1909 46 ft. by 4 ft. 8 in. Mr. A. B. Jackson reports three healthy trees at Ponfield, Herts. A tree at Coldhayes, near East Liss, Hants, was measured by Mr. Gamble as 36 ft. by 6 ft. 2 in. at the base.

In Ireland, the best specimen is at Castlemartyr, which Henry found to be 48 ft. by 4 ft. 11 in. in 1907. Another at Fota measured, in 1903, 40 ft. by 4 ft. 4 in. A large bushy tree with many stems from the ground at Woodstock, Kilkenny, was about 40 ft. high in 1909. Webster[4] mentions one at Churchill, Armagh, nearly 40 ft. high, growing on moist loam in an exposed situation.[5]

(H. J. E.)

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[1] *Waldungen Nordamerika*, 272 (1890).

[2] Cf. Gordon, in *Journ. Hort. Soc.* iv. 295 (1849).

[3] *Arboretum Notes*, 156. The tree at Barton is var. *pygmæa.*

[4] In *Gard. Chron.* xx. 624 (1896). Cf. also Webster, *Hardy Conif. Trees*, 38 (1896).

[5] While these pages were going finally through the press, I received specimens from Mr. Jepson, which shew that the trees of this species growing in Marin County and on Mt. Tamalpais bear larger cones than the type, with large reddish brown *glaucous* seeds. This form may be called var. *Sargentii.* Mr. Jepson's specimens shew various intermediate forms, one at least of which (from Monterey) is very probably a hybrid with *C. macrocarpa.*—(A. H.)

## CUPRESSUS MACNABIANA, Macnab's Cypress

*Cupressus Macnabiana*, Murray, in *Edin. New Phil. Journ.* i. 293, t. 11 (1855); Lindley, in *Gard. Chron.* 420 (1855); Carrière, in *Rev. Hort.* 1870, p. 155; T. Moore, in *Florist and Pomologist*, 88, *cum fig.* (1874); Engelmann, in Brewer and Watson, *Bot. Califor.* ii. 114 (1880); Masters, in *Gard. Chron.* ix. 403, fig. 90 (1891), and in *Journ. Linn. Soc.* (*Bot.*) xxxi. 347 (1896); Sargent, *Silva N. Amer.* x. 109, t. 528 (1896), and *Trees N. Amer.* 80 (1905); Kent, Veitch's *Man. Conif.* 213 (1900); Jepson, *Flora W. Mid. California*, 25 (1901), and *Flora Calif.* 61 (1909); Eastwood, *Trees of California*, 18 (1905).

*Cupressus nivalis*, Lindley, in *Gard. Chron.* 1855, p. 421.

*Cupressus glandulosa*, Hooker, ex Gordon, *Pinetum*, 64 (1858).

Usually a shrub with several stems, 5 to 10 ft. in height, rarely a small wide-branching tree, attaining 40 ft. in height and 4 ft. in girth. Bark thin, reddish brown, separating on the surface into long thin persistent scales. Branches of the fourth and succeeding years smooth and purplish brown. Branchlet systems arising irregularly and spreading at varying angles, tri-pinnate, with the pinnæ not disposed in one plane. Ultimate branchlets short, tetragonal, compressed, $\frac{1}{20}$ to $\frac{1}{24}$ in. wide, and $\frac{1}{40}$ in. thick. Leaves $\frac{1}{20}$ in. long, appressed, ovate, thick, obtuse; lateral ranks conduplicate; facial ranks convex from side to side and somewhat flattened; all usually marked on the back with a circular glandular pit, often exuding resin. In native specimens, the foliage on the back and front is often covered with white streaks, and is said to be very fragrant.[1]

Cones, ripening in the second year, erect on short stout stalks, globose, $\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter, reddish brown, more or less covered with a glaucous bloom; scales usually six, rarely eight, with prominent processes, those on the lower scales thin and recurved, those on the upper scales thickened, conical, more or less incurved. Seeds numerous, ten to twelve on each scale, dark brown, $\frac{1}{8}$ in. long, with resin-vesicles; wings very narrow.

*C. Bakerii*, Jepson, *Fl. Calif.* 61 (1909), of which I have seen no specimens, appears to be a variety with small and very glaucous cones, the umbos of which are short, conical, and not incurved. It is said to be a small tree growing on lava beds in south-eastern Siskiyou and south-western Modoc counties.

*C. Macnabiana* is a native of California and is common in the hill country of eastern Napa County, from Samuel's Springs to Pope Valley, and extends northwards through Lake County to Red Mountain on the east side of Ukiah Valley in Mendocino County. It also occurs in Trinity County between Shasta and Whiskeytown. Carl Purdy[2] gives an interesting account of this species on Red Mountain, on the eastern slope of which it forms a pure forest about half a mile square, composed of old gnarled twisted trees, 12 to 20 ft. high, and covered with moss; while on the western side there is a dense thicket of cypress bushes, 6 to 8 ft. high in exposed situations and 15 ft. high in the gullies. Seedlings were observed in areas swept by fire; and a few seeds carried down the stream to the gravelly flats in the valley had produced a grove of handsome pyramidal specimens. Miss Eastwood[1] says that this cypress is more partial to the banks of streams than to dry slopes, and is often associated with *C. Goveniana*, though no hybrids have been observed. She mentions trees 30 to 40 ft. high between Hopland and Highland Springs, very unsymmetrical and loosely branching in habit. M'Lean found it on the road from Callistoga to the Etna mines, and Dr. Parry collected it at Chico, in Butte County.

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[1] Miss Eastwood says that the fresh foliage has a delightful fragrance, somewhat like that of sandalwood with a flavour of pine-apple. Carrière, in *Rev. Hort.* 1870, p. 155, compares the odour to that of *pomme de Reinette*, and says that branches cut and put in water purify the air of a room.

[2] In *Garden and Forest*, ix. 233 (1896), reproduced in *Gard. Chron.* xx. 65 (1896).

This species was discovered by Jeffrey[2] in the Sierra Nevada in 1853, and was found soon afterwards in 1854 by W. Murray.[3] Lobb sent seeds in the latter year to Messrs. Veitch, who raised young plants,[4] remarkable, according to Lindley, for their glaucous green foliage and deep rich brown branchlets. They appear[5] to have borne without injury the severe winter of 1860. This cypress appears to be short-lived,[6] and having been neglected for many years, has almost gone out of cultivation, the best specimen we know being one at Highnam, 30 ft. high, forking near the ground, with the main stem 2 ft. 8 in. in girth at 18 in. from the base. This was bearing young and old cones and staminate flowers in February, 1910. A slender tree[7] in Kew Gardens, with wide spreading branches is about 20 ft. high; and another[8] at Brickendon Grange, Herts, 25 ft. high, and bearing fruit in 1909, is said to have been planted in 1860. There is also a small tree 15 ft. high at Bicton. Another about 8 ft. high, at Nymans, Handcross, was badly injured by frost last winter.

Elwes collected a specimen bearing fruit at Angers, France, in September, 1907. (A. H.)

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[1] In *Zoe*, v. 11 (1900).

[2] Jeffrey's account of his specimen, taken from the advice note of his packet of plants sent in 1853, is: "Juniperus, No. 1481, Sierra Nevada mountains, growing in barren sandy places. Tree 15 ft. high, 1 ft. diameter, Oct. 1st, 1853."

[3] In *Gard. Chron.* 1855, p. 420, the locality where Murray found the plant is said to be, "In California, about lat. 41°, at 5000 ft. elevation."

[4] Lindley had described these young plants as *C. nivalis*, but was anticipated in his publication of this name by A. Murray's *C. Macnabiana*.

[5] *Gard. Chron.* 1860, pp. 336, 362.

[6] Those in the Botanic Gardens at Glasnevin and Edinburgh died many years ago. In the Kew herbarium there is a specimen dated 1878, from a tree 10 ft. high, growing at the upper end of the lake at Tortworth Court; but it is no longer living.

[7] Obtained from Smith of Worcester in 1881.

[8] Growing at the margin of a plantation. There were formerly two much finer specimens here, growing on the lawn, which were removed some years ago.

## CUPRESSUS LUSITANICA, Mexican Cypress

*Cupressus lusitanica*, Miller, *Gard. Dict.* No. 3 (1768); Lambert, *Genus Pinus*, i. 95, t. 65 (1803); Loudon, *Arb. et Frut. Brit.* iv. 2477 (1838); Forbes, *Pin. Woburn.* 187, t. 62 (1840); Carrière, *Conif.* ii. 153 (1867); Masters, in *Journ. Roy. Hort. Soc.* xvii. 1 (1894), and *Journ. Linn. Soc.* (*Bot.*) xxxi. 331 (1896); Kent, Veitch's *Man. Conif.* 210 (1900).

*Cupressus pendula*, L'Héritier, *Stirp.* 15, t. 8 (1784) (not Thunberg).

*Cupressus glauca*, Lamarck, *Encycl.* ii. 243 (1786); Brotero, *Fl. Lusitanica*, i. 216 (1804); Endlicher, *Syn. Conif.* 58 (1847); Dalzell and Gibson, *Bombay Flora, Suppl.* 83 (1861); Hooker, *Fl. Brit. Ind.* v. 645 (1888); Masters, in *Gard. Chron.* x. 761, fig. 110 (1891); Cooke, *Fl. Presid. Bombay*, ii. 666 (1907).

*Cupressus Coulteri*,[1] Forbes, *Pin. Woburn.* 190 (1839).

*Cupressus Lindleyi*, Klotzsch, in Endlicher, *Syn. Conif.* 59 (1847); Hemsley, in *Biol. Cent. Amer.* iii. 183 (1882).

*Cupressus Ehrenbergii*, Kunze, in *Linnæa*, xx. 16 (1847).

*Cupressus Karwinskyana*, Regel, in *Gartenflora*, vi. 346 (1857).

*Cupressus sinensis*,[2] Lee, ex Gordon, *Pinetum*, 63 (1858).

*Cupressus mexicana*,[3] Koch, *Dendrologie*, ii. pt. 2, 159 (1873).

A tree, attaining in Mexico 100 ft. in height and 12 ft. in girth. Bark reddish brown, fissuring longitudinally into long thin brown strips. Branches widely spreading with pendulous branchlets. Branchlet systems alternate, not distichous, spreading at varying angles, bi-pinnate, with the pinnæ not disposed in one plane. Ultimate branchlets tetragonal, slightly compressed, 1/16 in. wide, 1/20 in. thick. Leaves nearly uniform in four ranks, 1/16 in. long, appressed, but slightly free at the tips, ovate-acuminate, often mucronate, convex from side to side, occasionally marked with a depressed circular pit.

Staminate flowers yellowish, 1/4 in. long; stamens about 20. Cones in the first year covered with a glaucous bloom, with the points of the scales spreading and reflexed; in the second year ripening and letting out the seeds, and remaining on the branches for about a year afterwards, globose, about 1/2 in. in diameter, on straight long stalks, dark reddish brown, but covered with a glaucous bloom, whitish and thick in trees growing in Mexico, France, and Portugal, faint or absent in England and Ireland; scales eight, each with a central, usually prominent, triangular and reflexed process. Seeds eight to ten on each scale, 1/6 in. long, brown, with conspicuous resin-vesicles; wing narrow with a translucent border.

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[1] The plant described by Forbes in 1839 as *C. Coulteri* was raised from seeds taken from a cone, said to have been fifteen years old, in Coulter's herbarium. Loudon, *Encycl. Trees*, 1077 (1842) states that this plant was raised at Glasnevin in 1837; but as Coulter did not arrive in Mexico till 1834 there must be some error in the age ascribed to the seeds. A specimen in the Kew herbarium, dated 1878, from the tree at Glasnevin is *C. lusitanica*, and this tree is probably one of the rare Mexican cypresses which was destroyed by a storm in 1878, as Mr. F. W. Moore informs me. Further storms in 1883 and 1893 swept away the remaining Mexican trees at Glasnevin. Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 348 (1896) is in error in identifying the specimen of *C. Coulteri*, preserved at Kew, with *C. Macnabiana*.

[2] Specimens cultivated under this name at Tokai, near Cape Town, are *C. lusitanica*.

[3] A tree cultivated under this name at Glasnevin, which was destroyed in 1878, is *C. lusitanica*, according to a branch preserved in the Kew herbarium.

### VARIETIES

A careful examination of all the native material in the Kew herbarium and in Lindley's collection at Cambridge, together with a study of the numerous examples in cultivation in England, Ireland, France, Italy, and Portugal, show that there is only one species of Cupressus in Mexico, comprising two main forms, distinguishable by their habit of growth, and resembling in this respect *C. sempervirens* and *C. macrocarpa*. Pringle writes to me as follows: "After a score of years of vain endeavour to distinguish several species of Cupressus on the mountains of Mexico, it is gratifying to learn that you think it possible that there exists only one variable species there. The Mexican cypress, so far as I have seen, varies no more in all its characters than any one of the admitted species of Mexican pines. Consider its distribution through sixteen degrees of latitude and from 4000 to 10,000 ft. altitude, and its growth in widely different soils, from the richest humus to the poorest volcanic soil, infinitely varying conditions which tell effectively on the character of the species."

1. The typical form, which has been described above, and which is identical in every particular with the "cedar of Goa," long cultivated in Spain and Portugal, is distinguished by its wide-spreading branches and pendulous branchlets, the ultimate ramifications of which arise at varying angles and are not disposed in one plane. The other form, usually cultivated as *C. Knightiana*, is distinguished as follows:—

2. Var. *Benthami*, Carrière, *Conif.* 155 (1867).

*Cupressus Benthami*, Endlicher, *Syn. Conif.* 59 (1847); Hemsley, in *Biol. Cent. Amer.* iii. 183 (1883); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 338 (1896); Kent, Veitch's *Man. Conif.* 201 (1900).
*Cupressus thurifera*, Schlechtendal, in *Linnæa*, xii. 493 (1838) (not Humboldt, Bonpland, and Kunth); Bentham, *Plant. Hartweg.* 57 (1840).
*Cupressus Knightiana*, Knight and Perry, *Syn. Conif.* 20 (1850); Carrière, *Conif.* i. 158 (1867).
*Cupressus Uhdeana*, Carrière, *Conif.* 129 (1855) (not Gordon).
*Cupressus elegans*,[1] Low, ex Koch, *Dendrologie*, ii. pt. 2, p. 156 (1873).

This variety usually forms a narrow pyramidal tree, with very regular branches. Branchlet systems and their pinnæ disposed in one plane. Ultimate branchlets more flattened and compressed than in the type, $\frac{1}{16}$ in. wide, $\frac{1}{32}$ in. thick. Leaves, lateral pair narrow, conduplicate, with acuminate free mucronate tips; facial pair flattened, ovate-acuminate; all usually marked with a central circular glandular depression. Bark, cones, and seeds, as in the type.

This variety occurs in the wild state in Mexico, and is represented in the Kew herbarium by specimens collected by Hartweg at Banco, by Bourgeau at Orizaba, and by Parry and Palmer at 6000 to 8000 ft. near San Luis Potosi, and is doubtless sporadic throughout the whole range of the species.

3. Var. *Skinneri.*

*Cupressus Skinneri*,[2] Carrière, *Conif.* 128 (1855).
*Cupressus excelsa*, Scott, ex Carrière, *Conif.* 128 (1855).

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[1] This is referred to as a garden name for *C. Knightiana*, in Carrière, *Conif.* 127 (1855).

[2] Skinner was one of the partners in the firm of Klee, Skinner, and Co., in Guatemala, and was much interested in natural history. Cf. Koch, *Dendrologie*, ii. pt. 2, 157 (1873).

This cypress which occurs in Guatemala, where it was collected[1] by Donnell-Smith at 5000 ft. altitude, does not differ from var. *Benthami* in botanical characters, but is perhaps more tender in cultivation. The late Lord Annesley raised some plants from seeds imported from Guatemala, one of which succumbed at Castlewellan to the frost of April 1908. Another plant given to Canon Ellacombe in 1897, is, however, thriving at Bitton and has attained 14 ft. in height.

4. Var. *glauca*. Specimens with very bluish glaucous foliage from Monserrat in Portugal may provisionally be distinguished by this varietal name. The leaves show usually the dorsal resin-gland, which is characteristic of *C. arizonica*, and afford evidence that the latter species is only a geographical form of *C. lusitanica*.

## DISTRIBUTION

This species is widely distributed in Mexico,[2] and extends into the high mountains of Guatemala. According to Pringle it is found at altitudes between 4000 and 10,000 ft., usually growing in the neighbourhood of mountain streams, and on moist slopes. It rarely forms a forest to the exclusion of other species, and even when crowded generally branches from near the ground. Pringle speaks, however, of a small wood straggling along brooks for a mile or more on the mountains overlooking the valley of Mexico on the south, the trees showing great variation in foliage and mode of branching. This species attains its largest size, 2 to 4 ft. in diameter, in damp volcanic soil on the plains at the base of the mountains, as near the city of Mexico. It is also generally planted in the towns of the southern tablelands. (A. H.)

The only place where I remember to have seen this beautiful tree in Mexico was in a grove of planted trees in the so-called "Sacro monte" at Amecameca, a village on the lower slopes of the great volcano of Popocatepetl, at an elevation of nearly 8000 ft. Here it was a picturesque tree with buttressed trunks 5 or 6 feet in diameter, and clothed with pendulous branches, which in many places were covered with Tillandsia and other epiphytes. Many of the trees were dying at the tops and seemed of great age. A good illustration of these trees is given under the name *C. Benthami* by Karsten and Schenck.[3] The vegetation and climate of this region is subtropical, and, though very dry at the season when I was there, has a long rainy season, and, as far as I could learn, little frost or snow.

## HISTORY

So far as I know, no account has been written in English of the forest of Bussaco, in Portugal, which is celebrated as the home of the tree called *Cupressus lusitanica*, Miller, by botanists, and popularly known as the cypress or cedar of Goa. An attempt to decide the origin of this tree was made by the late Dr.

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[1] Heyde and Lux also gathered specimens of *C. lusitanica* in the Santa Rosa department of Guatemala at 4000 feet altitude in 1892.

[2] Hartweg collected both the typical form and var. *Benthami* in Mexico in 1839.

[3] *Vegetationsbilder*, ii. t. 16 (1905).

Masters in the *Journal of the Royal Horticultural Society*, xvii. 1-11 (1894); but I cannot accept his conclusion that *C. sempervirens*, *C. torulosa*, and *C. lusitanica* may have all arisen from a common stock, and at a relatively not very remote period. All the trees that I have seen of *C. sempervirens* in England, Portugal, and other countries are of a very different habit, at all stages and under all conditions of growth. The same applies to *C. torulosa*.

Dr. Goeze's statement in his letter to Dr. Masters that the old monks' chronicles gave the Azores[1] as the native country of the tree is not supported by any historical or botanical evidence. I prefer to believe that it is of Mexican origin, as a careful comparison of numerous Portuguese and Irish specimens with native specimens of *Cupressus Lindleyi* from Mexico shows that Carrière and Koch[2] were correct in identifying *C. lusitanica* with that species. The tree may as easily have been introduced by Spanish friars[3] from Mexico as by Portuguese monks from Goa,[4] though we cannot now discover by whom and when; and as the real origin seems lost in antiquity, and the tree has for at least three centuries been naturalised in Portugal, the name of *C. lusitanica*[5] is not inappropriate.

I visited Portugal in April 1909, mainly with the object of studying on the spot the cypress and the oaks of Portugal, which are extremely variable and interesting. Professor Henriques, of Coimbra, was good enough to accompany me to Bussaco, which is reached by a short railway journey from Coimbra to Luzo; whence a drive of two miles brings one through the village to the entrance of the Royal domain, which was formerly the property of a Trappist monastery; on the site of which a large and beautiful hotel has been erected. The forest is surrounded by a wall about three miles long, and appears to be a virgin forest in which have been planted at various times, but mainly forty to fifty years ago by Rodrigo de Moraes Suares, an immense variety of exotic trees. The old monks appear to have planted the cypresses at first round the monastery, and later at many points along the roads and paths which lead to the nine entrances to the forest, but always singly or in lines, apparently for ornament alone. The oldest of these trees are still, with one or two exceptions, quite sound, and although difficult to measure on account of their being crowded by other trees, I was able to make the following measurements :—

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[1] In the Azores large logs of a coniferous timber are frequently found deeply buried under volcanic debris. A block of this wood, presented to the Kew Museum by Dr. Goeze, and supposed by Dr. Masters to be *Cupressus sempervirens* or *C. lusitanica*, has recently been examined at the Jodrell laboratory by Mr. Boodle, and proves to be that of a juniper, and is probably *Juniperus brevifolia*, Parlatore, a tree still common on the Azores. There are not any grounds for supposing that *C. lusitanica* ever inhabited the Azores. Cf. *Gard. Chron.* 1867, p. 929; Kent, Veitch's *Man. Conif.* 180 (1900); and Trelease, *Missouri Bot. Gard. Rep.* viii. 169 (1897).—(A. H.)

[2] Koch, *Dendrologie*, ii. pt. 2, p. 155 (1873), who describes the Mexican native species under the name *C. Coulteri*, Forbes, and *C. lusitanica* under the name *C. pendula*, L'Héritier, states that the former is probably the wild form of the latter, and adds that it is often impossible to distinguish one from the other.—(A. H.)

[3] *C. lusitanica* is common in cultivation in southern Spain, and there is a specimen at Kew labelled Los Martyres Monastery, Granada City. According to Willkomm and Lange, *Prod. Fl. Hispan.* i. 21 (1861), Guira found it apparently wild in Torre de Guil, at the base of the Sierra de Carrascoy, in Murcia.—(A. H.)

[4] The tree is unknown at Goa, and there is not a single specimen from any part of India in the Kew herbarium. Dalzell and Gibson, *Bombay Flora, Suppl.* 83 (1861), say: "Now common in gardens, native and European, does not succeed below the Ghauts, and above only where the soil is deep and rich. The healthiest appears to be those planted in front of Sir Jamsetjee's bungalow in Poona, but they are young and have their trials to go through." Gammie wrote from Poona, 17th July 1903: "Said never to fruit in the Bombay Presidency. This is the result of repeated inquiries on my part. It is by no means common in Poona now, as many plants were killed in the drought of 1899-1900." Brandis, *Forest Flora*, 534, and Hooker, *Fl. Brit. India*, v. 645, are apparently in error in stating that the tree is extensively cultivated in the western Ghats. No one, in any case, has ever seen old trees in India.

Hutchins, in *Gard. Chron.* xxxvi. 275 (1904) and xxxvii. 219 (1905), reports that he cultivated *C. lusitanica*, *C. sinensis*, and *C. torulosa*, so-called, at Tokai, near Cape Town, and concluded that the two former were cultivated varieties of *C. torulosa*. Hutchins kindly sent us copious specimens of the three forms, which he had in cultivation, and they are all *C. lusitanica*. He had not obtained true plants of *C. torulosa*.—(A. H.)

[5] *C. lusitanica* is the oldest name of the species, and is adopted by us on that account.—(A. H.)

1. A tree near the hotel, just below the road leading to the Coimbra gate, about 110 ft. by 11 ft. 2 in., with a clean bole about 40 ft. high.

2. A tree which M. Lacerda, the director of the domain, considers the largest of all, is 85 to 90 ft. high, with a bole of 30 ft., 15 ft. 10 in. in girth, and situated just below the small chapel of San José.

3. A little above this is a tree, perhaps 100 ft. high or possibly more, with a straight clean bole 66 ft. by 12 ft. 8 in.

4. Above the avenue of Mosteiro a very tall fine tree, possibly taller than No. 1, but I could not measure it.

5. A little way down towards the water-staircase a very large hollow tree, the only one which seems to be decayed, measured 15 ft. 10 in. in girth.

There is much variation in the form and habit of this cypress according to the situation; it seems capable of growing in fairly dense shade, and when crowded by other trees cleans its trunk well. Some fine young trees, said to be about fifty years old, in the deep moist hollow called the Valle dos Abietos, measured about 90 ft. high by 4 to 5 ft. in girth, and were clean to half their height. I have no doubt that these, in the course of another fifty years or so, will attain a greater height than any of the old ones, and may eventually equal, if not surpass, the splendid young silver firs which are growing in the same valley; whose seedlings come up as thickly and evenly as I have ever seen them do in their native country. The cypress, though it sows itself freely, requires more light when young, and reproduces best where a shallow bed of leaf-mould is partially exposed to the sun. In such places I found plenty of seedlings which seemed to have an excellent root system, and I was able to transplant some of them to the garden of Baron Soutelinho (Mr. A. Tait), of Oporto, and to send some small ones home by post.

Owing to the kindness of Senhor Lacerda I have received a fine plank and section of the wood, cut from a tree which shows 160 annual rings on a radius of 18 in.; it appears to be very similar to the wood of *Cupressus sempervirens.* This account[1] has been read by Prof. Henriques, who informs me that the mountain of Bussaco is on the inferior Silurian formation. With regard to the date of its introduction, he says that it must certainly have existed before 1634, when it was mentioned in a poem called *Soledades de Bussaco.* When the mountain was acquired by the Trappists from the monks of Vacarica in 1626, there was already a great variety of trees, forming a dense forest. The chapel of San José, near which the largest tree grows, was founded in 1644, and the *Chronicles of the Carmelite* (cap. xx. p. 110), published in 1721, speaking of this chapel, says that near it is found the first cypress, progenitor of all the others in the forest. In 1689 Tournefort, in the original manuscript of his *Voyage en Portugal*, which is now in Prof. Henriques' possession, describes the species as follows: *Cupressus lusitanica*, patula, fructu minori.

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[1] M. Jacques L. de Vilmorin, in *Bull. Soc. Dend. France*, 1907, p. 49, gives an interesting account of the forest of Bussaco, which he visited in 1906.

I saw this cypress growing at many other places in Portugal, but nowhere very large, except in the beautiful garden of Monserrat, formerly the property of Mr. Beckford, but purchased in 1855 by Sir Francis Cook, whose son, the present Sir Frederick Cook (Viscount Monserrate in Portugal), keeps up this unique place with the greatest care. The oldest cypresses here seem to have been planted something like a century ago, and are extremely varied in habit, as well as in the size, shape, and colour of their fruit. The tallest, in a low sheltered valley north of the house, was blown down a year ago, and measured 3 ft. 5 in. in diameter on the stump. It is said to have been taller than two trees still standing in the same place, one of which is from 105 to 110 ft. high by 10 ft. 5 in. in girth, the other being about 90 ft. by 12½ ft. In the Mexican garden there is an old tree about 70 ft. high, with a flat umbrella-shaped top and a trunk clean to about 50 ft.; several others on the slope just below the house are extremely unlike this in habit, having spreading branches down to the ground profusely covered with old cones, some of which were persistent on branches twenty to thirty years old. Some of these trees were very glaucous in colour, and had longer fruit with larger protuberances. The fruit was much more abundant on these comparatively young and spreading trees than on the tall old ones, and seed was escaping from the cones in the middle of April. Some trees were so covered with male flowers as to give them a yellow appearance, and these bore comparatively few cones.

## INTRODUCTION

This tree was in cultivation[1] in 1682 in the Chelsea and Fulham gardens and at Badminton, and was probably introduced from Portugal a short time previously. Miller, writing[2] in 1768, says that it was then rare in English gardens, and mentions large trees that had been killed by the frost of 1740 and 1762. It was probably re-introduced during the Peninsular War, when many officers must have seen this species at Bussaco; and Loudon[3] states as a fact that Lord Ferrard brought seeds to Ireland in 1809, which produced many plants. Plants were raised[4] at Glasnevin in 1837 from seeds obtained from Coulter's Mexican specimens; and in all probability Hartweg sent seeds from Mexico in 1840 to 1843.

Var. *Benthami* was introduced, according to Loudon,[5] under the name *C. thurifera*, in 1838, when there was a plant a few inches high in the Horticultural Society's garden at Chiswick. In 1843, a plant[6] 7 ft. high was growing in Lucombe, Pince, and Co.'s nursery at Exeter. Uhde,[7] who was Prussian Consul at Matamoras, in Mexico, also sent seeds soon afterwards to Berlin, the plants from which were known as *C. Uhdeana*. This variety was sent out under the name *C. Knightiana* by Knight and Perry, who stated[1] their ignorance of its origin in 1850; but in all probability their plants were raised from seed sent by Hartweg.

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[1] Cf. Masters, in *Journ. Roy. Hort. Soc.* xvii. 5 (1894). It is mentioned by Ray, *Hist. Plant.* ii. 1414, 1798, 1916 (1688).

[2] *Dict.* ed. 8, No. 3 (1768).

[3] *Arb. et Frut. Brit.* i. 109 (1838).

[4] Loudon, *Trees and Shrubs*, 1077 (1842).

[5] Loudon, *Arb. et Frut. Brit.* iv. 2480 (1838).

[6] *Gard. Mag.* xix. 36 (1843).

[7] Cf. Koch, *Dendrologie*, ii. pt. 2, p. 154 (1873).

### REMARKABLE TREES

In England[2] we know of no trees which can be certainly distinguished as of Portuguese origin.

There is a fine one at Hemsted Park, Cranbrook, which measured 50 ft. by 10 ft. in 1905, and seems to be a very old tree (Plate 300). At Westonbirt there are two good trees, about 50 ft. high, somewhat differing in habit, one with rather wide-spreading branches, which was bearing cones in 1909; the other, a narrow pyramidal tree, was without fruit in that year. At Luscombe Castle, Dawlish, a tree, which I saw in 1908, was about 50 ft. by 5 ft. There are several trees in Cornwall, which Mr. A. B. Jackson measured in 1909; at Heligan, a good specimen, 40 ft. by 6 ft. 8 in.; and at Glendurgan, two trees, the larger, 40 ft. by 4 ft. 11 in. There are smaller ones at Liphook, and at Grayswood, Haslemere. This species is not hardy at Barton,[3] Suffolk, where all the specimens were killed in the winter of 1860-61.

In Ireland this species thrives at several places. The finest,[4] perhaps, is at Woodstock, and in 1909 measured about 57 ft. by 10½ ft., dividing low down into six large stems, and bearing many new and old cones. The forester informed me that 23° of frost had been registered here.

Loudon records a tree at Oriel Temple, Co. Louth, now the seat of Lord Masserene, which was 32 ft. high in 1834, and had been raised, as stated above, from seed brought from Portugal by Lord Ferrard in 1809. I visited this place in July 1908, and found no less than three large trees, which may be of the same age. The first is a stunted tree, with a wide-spreading crown 19 yards in diameter, and a short trunk only 4 ft. high and 7 ft. 7 in. in girth. It was covered with new fruit, while those of the preceding year remained, and contained plenty of ripe seed. The second is a much finer tree (Plate 301), about 40 ft. high, with spreading branches and a straight trunk 8 ft. 1 in. in girth and about 20 ft. high. The third is forked near the ground, where it is 7 ft. 9 in. in girth, and it is about 40 ft. high, with wide-spreading branches.

A tree at Kilmacurragh, which is probably of the same age and origin, is 48 ft. by 8 ft., with a bole of 10 ft. high. From it a cutting was struck many years ago (as I was informed by Mr. Moore, of Glasnevin) which has now grown into a fine tree, and had abundance of new and old fruit containing ripe seeds.

There is a tree[5] at Rostrevor House probably of the same origin as those at Oriel Temple. At Fota there is a fine specimen, cultivated under the name

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[1] *Syn. Conif.* 19 (1850).

[2] We have seen no trees in Scotland. The specimen at Rossdhu, Dumbartonshire, reported in *Journ. Roy. Hort. Soc.* xiv. 507 (1892), was incorrectly named, and is *C. Lawsoniana.* Cf. Masters, in *Journ. Roy. Hort. Soc.* xvii. 1, note (1894).

[3] Bunbury, *Arboretum Notes*, 155.

[4] This tree measured at 2 ft. from the ground 3 ft. 9 in. in 1825, 4 ft. 8 in. in 1834, 6 ft. 8 in. in 1854, and 6 ft. 8½ in. in 1860.

[5] A much larger tree than the one now standing at Rostrevor was blown down in 1903.

*C. Macnabiana*, which was 55 ft. by 6 ft. 3 in. in 1907. There is also a fine tree in the old deer park, Castlemartyr, about 60 ft. high, which Henry saw in 1907. At Birr Castle, King's County, the Earl of Rosse informs us that there is an old tree, 8 ft. in girth at 2 ft. from the ground, and dividing above this into many stems.

In England we have distinguished as belonging to var. *Benthami* a tree at Lamorran, Cornwall, which Mr. A. B. Jackson measured as 49 ft. high in 1909.

At Culver, Exeter, a tree, raised from seed brought by Mr. Byrom from the south of France in 1879, measured, in 1909, 35 ft. high, and 7 ft. in girth close to the ground.

In a sheltered dell at Bicton, there is a tree—No. 286 in the Bicton MS. catalogue—of var. *Benthami*, which, though the main stem is broken off some distance from the ground, measured, in 1906, 56 ft. in height, and 12½ ft. in girth at the base. There are two tall trees, close to it, of which No. 290 is typical *C. lusitanica*, and No. 274 is *C. torulosa*. No. 283 in the same dell, a tall narrow tree, labelled *C. religiosa*, and 55 ft. by 7 ft. in 1909, is *C. lusitanica*, var. *Benthami*. There was formerly a tree of var. *Benthami* growing near the Rhododendron dell at Kew, which was cut down about twelve years ago. A specimen preserved in the Arboretum herbarium shows that it produced fruit freely.

In Ireland the largest tree of this variety grows on Fota Island (Plate 302), and measured no less than 75 ft. high by 7 ft. 4 in. in girth in 1908. Lord Barrymore informs us that his beautiful specimens of *Abies religiosa* and *Pinus patula* were sent by J. Knight in 1844, and planted in 1847. He suspects that this tree, long known under the name *C. Lindleyana*,[1] was of the same origin. There is another of similar habit at Woodstock which in 1909 was 57 ft. by 6 ft. 3 in.

In the nursery of Rovelli Frères at Pallanza, there is a fine specimen of typical *C. lusitanica*, 50 ft. by 6 ft. 8 in. in 1909, which is erroneously labelled *Cupressus sp., Hills of India*.[2] Var. *Benthami* is represented by several large trees, which are named incorrectly *C. elegans* and *C. Hügelii*. (H. J. E.)

## CUPRESSUS ARIZONICA

*Cupressus arizonica*, Greene, in *Bull. Torrey Bot. Club*, ix. 64 (1882); Rusby, in *Bull. Torrey Bot. Club*, ix. 79 (1882); Masters, in *Gard. Chron.* x. 364 (1891); Sargent, *Silva N. Amer.* x. 105, t. 526 (1896), and *Trees N. Amer.* 78 (1905); De Wildeman, *Icon. Hort. Then.* iv. 111, t. 145 (1903); Purpus, in *Mitt. deut. dend. Ges.* 1904, p. 50, t. iv.; Eastwood, *Trees of California*, 17 (1905).

*Cupressus guadalupensis*, Sargent, *Tenth Census Report, U.S. Forest Trees N. Amer.* 180 (1884) (not Watson).

*Cupressus Benthami*, Endlicher, var. *arizonica*, Masters, *Kew Hand-list Coniferæ*, 37 (1896), and in *Journ. Linn. Soc.* (*Bot.*) xxxi. 340 (1896).

A tree attaining in Arizona a height of 70 ft. and a girth of 12 ft. Bark reddish brown, separating on the surface into long shreds, which are about 1 in. or

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[1] This name goes to show that Knight and Perry raised from Mexican seed both the type *C. lusitanica* (*C. Lindleyi*) and the variety *C. Benthami* (*C. Knightiana*).

[2] This is erroneously referred to it in *Mitt. deut. dend. Ges.* 1906, p. 98, as a juvenile form of *C. torulosa*. The small plants at Pallanza, labelled "*Cupressus* from Kumaon," are very glaucous, and may be a form of *C. lusitanica*; but are too young to be accurately determined. I have raised plants, which have hitherto proved hardy at Colesborne.

2 in. wide, and often persist for many years. Branchlets of the third year purplish brown, terete, smooth, and often covered with a glaucous bloom. Branchlet systems irregularly disposed at varying angles, bi-pinnate, with the pinnæ not in one plane. Ultimate branchlets tetragonal, equal-sided, $\frac{1}{20}$ in. in diameter. Leaves light green or conspicuously glaucous, uniform in four ranks, appressed, marked with a glandular pit on the back exuding resin, ovate-acuminate and $\frac{1}{12}$ in. long on young trees, ovate-acute and $\frac{1}{20}$ in. long on old trees.

Cones, on short stout straight stalks, globose, $\frac{1}{2}$ in. to $\frac{3}{4}$ in. in diameter, covered with a thick whitish bloom, ripening in the second year; scales usually six, occasionally eight, with spreading or incurved prominent processes. Seeds, eight to ten on each scale, $\frac{1}{8}$ in. long, marked with a few inconspicuous resin-vesicles; wings narrow.

This species is probably a northern form[1] of *C. lusitanica*, but is distinguishable by the peculiar pits on the leaves, which exude a whitish resin. The foliage, closely appressed to the stout quadrangular branchlets, often glaucous in colour, and covered with a protecting layer of resin, is adapted, through diminution of evaporation, for arid sunny regions. *C. arizonica* is a native of the mountains of central, eastern, and southern Arizona, and also occurs in the provinces of Sonora and Chihuahua in northern Mexico. It was discovered in 1880 by Greene near Clifton in eastern Arizona, and shortly afterwards was seen by Rusby in the San Francisco mountains of the same state, where it is abundant in the cañons and on northern slopes, forming almost pure forests of considerable extent[2] at 5000 to 6000 ft. altitude. Like most species of cypress it is variable in habit, tall and narrow, or short with wide-spreading branches, and showing all tints of foliage from light green to silvery white. Purpus, who gives a picture of the tree[3] in the Mogollones mountains, says that it grows there on rocky places on the cliffs on the sandstone formation.

*C. arizonica*, introduced[4] into England in 1882 from the Arnold Arboretum, U.S.A., has proved considerably hardier than its near relative *C. lusitanica*, and promises to be a most valuable ornamental tree. At Cambridge it is one of the few cypresses that thrive out of doors, and is fast in growth. The finest specimen we know is growing in Messrs. Hillier's nursery at Shroner, Winchester, and is now about 25 ft. high; it bears occasionally a few cones, and is said to have been planted in 1889. Another at Nymans, Handcross, was planted in 1899 when about 3 ft. high, and is now 20 ft. high by 1 ft. 3 in. in girth, and is bearing cones which show in the mature state none of the thick white glaucous bloom so characteristic of the fruit in Arizona. None of the plants that I have seen in England show any glaucous hue on the branchlets. Another tree, similar in size at the same place, procured in the south of France, with bluish glaucous foliage, has not yet borne cones. A plant at Castlewellan, 9 ft. high, bore fruit in 1909. At Trebah, Cornwall, a tree, obtained from Messrs. Veitch about 1892, is 15 ft. high, but has not as yet produced cones.

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[1] Scarcely distinguishable in botanical characters from *C. lusitanica*, var. *glauca*.

[2] In *Garden and Forest*, viii. 22 (1895), mention is made of a large grove, containing many thousands of trees, at the Natural Bridge in central Arizona.

[3] In *Mitt. deut. dendr. Ges.* 1904, p. 50.

[4] *Gard. Chron.* x. 364 (1891).

Seeds were introduced into Germany by Purpus,[1] who says it is the hardiest of all the true cypresses, and that young seedlings grow extraordinarily fast, but are somewhat difficult to transplant. Beissner,[2] however, states that in many parts of Germany it is tender and has suffered much from frost.

At Angers there is a tree of this species with remarkably glaucous silvery foliage, which bore fruit in 1907. Elwes found this also in E. Rovelli's nursery at Pallanza. He also saw a fine specimen under the name *C. guadalupensis* in the Botanic Garden at Montpellier. It was about 30 ft. high, with handsome glaucous foliage, but bore no fruit. (A. H.)

## CUPRESSUS OBTUSA, Hinoki Cypress

*Cupressus obtusa*, Koch, *Dendrologie*, ii. pt. ii. p. 168 (1873); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 355 (1896); Kent, Veitch's *Man. Conif.* 220 (1900).

*Chamæcyparis obtusa*, Siebold et Zuccarini, ex Endlicher, *Syn. Conif.* 63 (1847); Mayr, *Fremdländ. Wald- u. Parkbäume*, 277 (1906).

*Chamæcyparis breviramea* and *pendula*, Maximowicz, in *Mél. Biol.* vi. 25 (1866).

*Retinispora obtusa*, Siebold et Zuccarini, *Fl. Jap.* ii. 38, t. 121 (1844).

*Thuya obtusa*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 491 (1881).

A tree, attaining in Japan 120 ft. in height and 12 ft. in girth, larger trees of very rare occurrence being reported by Mayr. Bark reddish brown, scaling off in long thin strips. Branches and branchlet systems similar to those of *C. Lawsoniana*. Ultimate branchlets flattened, compressed, $\frac{1}{15}$ in. wide. Leaves appressed; lateral pair conduplicate, $\frac{1}{12}$ in. long, obtuse at the apex, which often bears a minute mucro; facial pair, much smaller, $\frac{1}{24}$ in. long, flattened, rhomboid, often keeled, non-glandular, with a triangular scarcely acute apex. The foliage is dark green on the upper side of the branchlet, but is marked below with X-shaped white markings, due to a coating of wax on the inner margins of the lateral leaves and on both margins of each ventral leaf. Leaves on the main axes oblong, unequal, the lateral $\frac{1}{4}$ in. long, the facial $\frac{1}{8}$ in. long, with spreading rather obtuse tips.

Staminate flowers yellow. Cones on the ends of short scaly branches, ripening in the autumn of the first year, and falling in the following year, globose, $\frac{1}{3}$ in. in diameter, orange brown when ripe; scales eight, rarely ten, with the outer surface depressed in the centre, from which arises a minute ovate appressed process. Seeds, two to five on each scale, ovate, $\frac{1}{8}$ in. long, brown, with conspicuous large resin-vesicles and narrow wings.[3] Seedling with two cotyledons, which are about $\frac{1}{4}$ in. in length.

### Varieties

This species has long been cultivated in Japan, where it has given rise to numerous peculiar varieties.

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[1] Cf. *Mitt. deut. dendr. Ges.* 1906, p. 32.

[2] *Ibid.* 1908, p. 61.

[3] Some seeds from a tree growing at Nikko have three wings, instead of the normal lateral two wings.

1. Var. *breviramea*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 355 (1896).

Var. *filicoides*, Masters, in *Kew Handlist Conif.* 45 (1896).
*Chamæcyparis breviramea*, Maximowicz, *Mél. Biol.* vi. 25 (1866); Beissner, *Nadelholzkunde*, 97 (1891).
*Thuya obtusa*, Masters, var. *breviramea*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 494 (1881).
*Thuya obtusa*, Masters, var. *filicoides*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 494, fig. 5 (1881).
*Retinispora filicoides*, Veitch, ex Gordon, *Pinetum*, 363 (1875); Syme, in *Gard. Chron.* v. 235, fig. 40 (1876).
*Retinispora Nobleana*, Beissner, *Nadelholzkunde*, 94 (1891).

Denser and dwarfer in habit, with sub-opposite oblong branchlet systems, composed of short equal closely-set opposite pinnæ. Ultimate branchlets tetragonal, scarcely compressed. Leaves nearly equal in four ranks, ovate, obtuse, often glandular. The foliage is usually dark green, but is occasionally marked with white streaks beneath. The cones are similar to, but slightly smaller than those of the type.

Maximowicz saw this peculiar form wild on the northern shore of the island of Kiusiu, but states that it is often cultivated in gardens at Tokyo. It was introduced[1] by J. Gould Veitch in 1861. A small tree of this variety is growing well at Tregothnan; and at Haldon, Exeter, it is about 20 ft. high and was bearing yellow staminate flowers in April 1908.

2. Var. *tetragona aurea*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 355 (1896).

Var. *filicoides aurea*, Kent, Veitch's *Man. Conif.* 221 (1900).
*Retinispora tetragona aurea*, Kent, Veitch's *Man. Conif.* 250 (1881).
*Chamæcyparis obtusa*, Siebold et Zuccarini, var. *tetragona aurea*, Beissner, *Nadelholzkunde*, 95 (1891).

A dwarf form, with tufted branchlet systems, the pinnæ of which arise at varying angles in different planes. Ultimate branchlets tetragonal, scarcely compressed; leaves nearly uniform, ovate, acute, spreading at the tips. Young shoots golden yellow, becoming dark green in the second year.

This originated in the Elvaston Nursery in 1873, and obtained a first-class certificate at the Royal Horticultural Society in 1876. It is very slow in growth, a plant at Castlewellan being only 5 ft. high after twenty years' growth.[2]

3. Var. *lycopodioides*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 355 (1896).

*Retinispora lycopodioides*, Standish, ex Gordon, *Pinet. Suppl.* 92 (1862).
*Retinispora monstrosa*, Gordon, *loc. cit.*
*Thuya obtusa*, Masters, var. *lycopodioides* in *Journ. Linn. Soc.* (*Bot.*) xviii. 493 (1881).
*Chamæcyparis obtusa*, Siebold et Zuccarini, var. *lycopodioides*, Carrière, *Conif.* 132 (1867).

A dwarf form with rigid branches. Branchlet systems closely set, overlapping, but tending to be in one plane. Ultimate branchlets fasciated, crowded with closely appressed, elongated, obtuse leaves in many ranks. Foliage dark green in colour.

According to Gordon this was sent by Fortune to the Bagshot Nursery in 1861; but it is stated by J. H. Veitch[3] to have been introduced in the same year by J. Gould Veitch. There are fine shrubs of this variety at Tregothnan, at Coldrenick, and at Chipping Campden in the garden of Mr. Griffiths.

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[1] *Hortus Veitchii*, 339 (1906).

[2] Earl Annesley, *Beautiful Trees*, 74 (1903).

[3] *Hortus Veitchii*, 339 (1906).

4. Var. *pendula*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 355 (1896).

*Chamæcyparis pendula*, Maximowicz, *Mél. Biol.* vi. 26 (1866).

A form resembling *Thuya orientalis*, L., var. *pendula*, Masters, in habit, with long pendulous branches, and tetragonal branchlets and obtuse leaves.

This was seen by Maximowicz in gardens around Tokyo; but does not seem to be known in Europe, unless it is identical with an extremely handsome pendulous form,[1] which originated from Japanese seed sown in Prince Lobkowitz's nursery at Eisenberg in Bohemia.

The principal forms, which only differ from the type in the colour of the foliage are:—

5. Var. *aurea*. Young branchlets golden yellow. This is said to have been sent from Japan by Fortune to the Bagshot Nursery. According to the late Earl Annesley, it is dense in habit, holding its rich colour in spring and early summer. Kent considers it to be the most remarkable of all the coloured conifers.[2] In var. *gracilis aurea*, the branches are pendulous, with yellow branchlets, turning to light green when mature. Var. *Keteleeri*, though said by Parlatore[3] to have juvenile foliage, is described by Gordon[4] as resembling the type in every respect, except that about half the branchlets are yellow; and apparently this was early introduced from Japan. Var. *Crippsii*, at Kew, is a form with pale yellow young branchlets. A shrub cultivated at Osborne as var. *nana aurea*, planted in 1873, is now about 15 ft. high.

6. Var. *albo-spica*. Young shoots cream coloured when they first appear, gradually changing to pale green in summer. Var. *argentea*, introduced from Japan by Fortune, is similar, but silvery white or glaucous.

7. The principal dwarf forms are var. *nana* and var. *compacta*. The latter has lately produced[5] fertile seeds, but the seedlings are too young as yet to judge of their precise character. Var. *pygmæa* scarcely exceeds a foot in height and spreads horizontally on all sides, and is much used for rockeries.

8. Var. *Troubetzkoyana*, Rovelli, ex Masters, in *Gard. Chron.* vii. 108 (1890).

A dwarf compact form, densely branched, with short, divaricating branchlets, and appressed light green, rather thick, lanceolate, acute but not acuminate leaves, which bear a central gland on the back. This originated at Pallanza, in the garden of Prince Troubetzkoy.

9. Var. *erecta*. A fastigiate variety, like *C. Lawsoniana*, var. *erecta viridis*. Introduced by Waterer and Sons.[6] (A. H.)

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[1] Described as *Chamæcyparis obtusa pendula*, by Beissner, *Nadelholzkunde*, 96 (1891).

[2] Mayne, in *Gard. Chron.* xli. 217 (1907) reports two specimens 25 ft. high at Bicton.

[3] In DC. *Prod.* xvi. 2, p. 466 (1868).

[4] *Pinetum*, 368 (1875).

[5] Cf. *Proc. Roy. Hort. Soc.* xxxiv. p. ccxix. (1908).

[6] It obtained a first-class certificate at the Horticultural Society, according to *Gard. Chron.* 1870, p. 315.

## DISTRIBUTION

In Japan this tree is indigenous, so far as I could learn, only in the central and southern parts of the main island, and in Kiusiu and Shikoku; but it is so highly valued for its timber, which is considered the best of all the soft woods of Japan, that it has been largely planted in many places, and is always found in the grounds of Shinto temples, which are usually built of its wood. It is one of the five royal trees which were reserved for imperial and religious uses in ancient times; and is known in Japan as *Hinoki*.

The best natural forests which I saw are in the districts of Kisogawa and near Koyasan, where the tree grows at an elevation of from about 2000 to 5000 ft. on rich volcanic and granitic soil, usually mixed with *C. pisifera* and other conifers and hardwood trees, and sometimes attains very large dimensions. It is not easily distinguished in the forest from *C. pisifera*, but has smoother and paler bark; and the branches have a more ascending and less drooping habit.

Though in the forest the trees do not usually attain more than 80 to 90 ft. high, yet I saw many at Koyasan over 100 ft., and measured one close to the gate of the great temple at Koyasan which was 108 ft. by 12½ ft.; and in the temple court at Nikko there were two fine trees said to be about 300 years old, and nearly as large.

Plate 303 shews an isolated tree which I found at Maichi near Nikko. Plate 304 represents a tree grown in forest for timber.

Mayr says that at its upper limit, where it mingles with *Picea Alcockiana* and *P. hondoensis*, it attains about 80 ft., but that on good soil, mixed with chestnuts and other hardwoods, over which its crown towers in the forest, it attains 140 ft. in height and 7 ft. in girth, with a stem clear of branches to 60 ft. The largest tree recorded by Mayr grew in Mitzumine, mixed with Zelkova, maples, and oaks.

In Japan the reproduction by seed is easy; and though the growth is much slower than that of Cryptomeria, yet *C. obtusa* is preferred for planting wherever the soil and climate are suitable.

This species has recently been discovered in Formosa, growing on Mount Morrison, with leaves, cones, and seeds somewhat smaller than is usual in Japan.[1]

## CULTIVATION

This species was introduced into cultivation in Europe by J. Gould Veitch in 1861, and has become popular as an ornamental small tree in English gardens. It is perfectly hardy, but probably requires more heat than our climate affords to bring it to timber size; and being generally propagated by cuttings is usually seen in a shrubby form. It dislikes lime in the soil, and, according to Mr. Coleman, does not thrive on that account at Eastnor. It ripens its seed perfectly in the south of England.

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[1] Distinguished as *forma formosana* by Hayata in *Gard. Chron.* xliii. 194 (1908), and in *Journ. Coll. Sc. Tokyo*, xxv. 208 (1908). Mr. Hayata informs us that this tree attains an enormous size in the mountains of Formosa.

The largest trees which we have seen are one at Bicton, 36 ft. by 4 ft. 4 in. in 1906; and another at Dinas Mawddy, 30 ft. by 2 ft. in 1906, growing well on slate here and at Tan-y-bwlch. There are good specimens also at Tortworth, Westonbirt, Campden (Gloucestershire), and at Castle Kennedy in Scotland. In Ireland it grows well, a tree at Woodstock, Kilkenny, 38 ft. high, having a number of layered branches, which are now growing erect round the parent.

This species has been tried at fourteen different forestry stations in Prussia, the plots amounting to 10 acres in extent. Dr. Schwappach[1] says that seedlings grow slowly in the first two years, but attain in five years 20 to 40 in. in height, in ten years 5 to 9 ft., and in fifteen years 11 to 15 ft. Young plants are susceptible both to heat and to frost; and he advises planting out well-rooted transplants at five years old in gaps in woods of broad-leaved trees. This species, like all of the section Chamæcyparis, seems very liable in Germany to attacks of the fungus, *Pestalozzia funerea.*

In New England[2] *C. obtusa* is quite hardy, and in its early years makes a handsome plant, but it soon develops a tendency to grow thin, and well-furnished specimens more than 20 ft. high are not common.

## TIMBER

No coniferous timber is now so highly valued in Japan for the finest buildings, as well as for interior work, as that of the Hinoki; and Sargent says that the palaces of the Mikado, as well as the temples, are built of it. But the high-priest of the Gemyo-in Temple, where I stayed at Koyasan, said that the wood of Tsuga used to be preferred until it became too scarce. To this very courteous gentleman I am indebted for a large slab 3 ft. across, cut from a burr of this tree, which was quite free from flaws, sound to the centre, and showed a very twisted and varied grain; in colour resembling satinwood, from which a highly ornamental table top has been made in England, the legs and framing of which are of Japanese yew.

Hinoki wood is white, straw-colour, or pale pink, very straight-grained, light, strong, and tough, and is distinguished by its remarkably fine-grained and silky lustre, which make it suitable for lacquer. Neat round rice-boxes are made in Kiso from thin pieces of this wood, ⅛ of an inch thick, bent into a circle, and sewed with cherry bark, which are sold for a few sen. For any fine work requiring a perfect surface it seems to me unsurpassed among coniferous woods, resembling most nearly in texture that of *Cupressus nootkatensis.*

The most beautiful ceiling which I saw in Japan, in a new inn at Nakatsugawa, was made from thin boards of this wood, about 18 in. square, cut from the butts of old trees, and showing a most varied wavy figure. These cost on the spot about fifteenpence each, and if they could be imported would be highly valued in Europe. The wood is also used for making chip braid; and an ordinary quality is worth in Tokyo about 80 yen or £8 per 100 cubic feet. The bark is also highly valued for roofing temples and palaces. This bark is stripped from living trees, and as I was informed by a forester at Koyasan, this can be done about once in ten years without injuring the tree. It was worth 2s. to 4s. per tree. It is used for roofing in strips of about a foot long by 3 to 6 in. wide, which are laid together in packets of eight or ten strips, and put on the roof to the thickness of about a foot, the eaves and ridge being protected with wood or bamboo work. Such a roof will last for about fifty years even in this damp hot climate. (H. J. E.)

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[1] *Anbauvers. Fremdl. Holzarten*, 28 (1901).

[2] Sargent, *Garden and Forest*, x. 431 (1897), and *Pinetum Wellesley*, 13 (1905), where a tree is said to have attained 31 ft. high in Mr. Hunnewell's pinetum.

## CUPRESSUS PISIFERA, Sawara Cypress

*Cupressus pisifera*, Koch, *Dendrologie*, ii. pt. ii. p. 170 (1873); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 355 (1896); Kent, Veitch's *Man. Conif.* 224 (1900).

*Chamæcyparis pisifera*, Siebold et Zuccarini, ex Endlicher, *Syn. Conif.* 64 (1847); Mayr, *Fremdl. Wald- u. Parkbäume*, 276 (1906).

*Retinispora pisifera*, Siebold et Zuccarini, *Fl. Jap.* ii. 39, t. 122 (1844); Syme, in *Gard. Chron.* v. 235 (1876).

*Thuya pisifera*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 489 (1881).

A tree similar to *C. obtusa* in dimensions, bark, branches, and branchlets. Ultimate branchlets flattened, $\frac{1}{16}$ to $\frac{1}{12}$ in. wide. Leaves appressed, but with their mucronate tips free and slightly spreading; lateral pair conduplicate, acute; facial pair slightly smaller, $\frac{1}{16}$ in. long, ovate-acuminate, flattened, often ridged, obscurely glandular. The foliage is shining green above, while below it is marked with conspicuous white patches in hollows, two on the bases of the lateral leaves towards the middle line, and two on the base of each ventral leaf. Leaves on the main axes equal in four ranks, oblong, $\frac{1}{8}$ to $\frac{1}{5}$ in. long, with spreading triangular acuminate points.

Staminate flowers yellowish, with eight or ten pairs of stamens. Cones on the ends of short scaly branchlets, ripening in the autumn of the first year, and falling in the second year, globose, $\frac{1}{4}$ in. in diameter, dark brown; scales usually ten, with the outer surface wrinkled, deeply depressed in the centre, from which arises a very minute process. Seeds, one or two on each scale, brown, ovate, with large prominent resin-vesicles, $\frac{1}{10}$ in. long and $\frac{1}{5}$ in. wide, inclusive of their broad lateral wings, when these are well developed. Seedling with two cotyledons, similar to that of *C. Lawsoniana.*

### Varieties

This species has been cultivated for centuries in Japan, and has given rise to many varieties.

1. Var. *squarrosa*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 356 (1896).

*Retinispora squarrosa*, Siebold et Zuccarini, *Fl. Jap.* ii. 40, t. 123 (1844); Kent, Veitch's *Man. Conif.* 249, fig. 59 (1881).

*Chamæcyparis squarrosa*, Siebold et Zuccarini, ex Endlicher, *Syn. Conif.* 65 (1847).

*Cupressus squarrosa*, Lawson, ex Gordon, *Pinetum*, 296 (1858).

*Thuya pisifera*, Masters, var. *squarrosa*, Masters, in *Journ. Linn. Soc.* (*Bot.*) 490 (1881).

This variety, which retains indefinitely the juvenile form of foliage, occurring on seedlings in their first three or four months, is a low tree or large dense shrub, with glaucous silvery foliage; ultimate branchlets tetragonal; leaves soft in texture, in opposite decussate pairs or whorls of fours, decurrent on the branchlet, sessile, linear, flattened, ¼ in. long, whitened on both surfaces, acuminate. The bluish tint of the foliage is very handsome.

According to Siebold, "it is said to occur wild in Kiusiu," but in all probability it is only known in the cultivated state in Japan, where it is called *Himuro* or *Shimofuri-hiba*. It was introduced into Europe in 1843, and for a long time was considered to be a distinct species; but Syme[1] in 1879 found a tree of this variety giving off a branch with foliage exactly like that of *C. pisifera*; and in 1882 it produced[2] fruit with Messrs. Veitch, unmistakably the same as the species. Elwes brought from Japan specimens in fruit collected by Watanabe on Nokogiri-yama. The seed produced in England appears to be unfertile.

Syme first showed[3] the true nature of these Retinispora forms. In 1875 he raised 2000 seedlings of *C. pisifera*, many of which were 2 ft. high in 1879. These seedlings during the first four months resembled *Retinispora squarrosa*, but towards the end of the season the great majority assumed the branchlets and leaves of *R. plumosa*, and in the following year developed the adult foliage of *C. pisifera*. A few of the seedlings, however, did not change from the juvenile stage till they were two years old, and one plant when three years old changed into the plumose stage, and remained so. Probably var. *squarrosa* and var. *plumosa* originally were accidental seedlings; but in most cases now plants of the different stages of Retinispora are artificially produced by propagation from cuttings. Hochstetter[4] states that if lateral branches are used as cuttings, Retinispora forms are produced, while terminal shoots give *C. pisifera*. Var. *squarrosa* and var. *plumosa* can also be produced by using offsets from young seedlings of *C. pisifera*.[4]

A sub-variety, known as var. *squarrosa sulphurea*, yellowish in colour, is known; and Mr. Paul has a specimen of this at Cheshunt, which is growing into the form *plumosa*, while still retaining its colour.[5]

This variety[6] has attained 29 ft. in height at Wellesley, Massachusetts, U.S.A.

2. Var. *plumosa*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 356 (1896).

*Retinispora plumosa*, Veitch, ex Koch, *Dendrologie*, ii. pt. ii. p. 170 (1873); Syme, in *Gard. Chron.* v. 236, fig. 42 (1876).
*Thuya pisifera*, Masters, var. *plumosa*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 490, fig. 2 (1881).
*Chamæcyparis pisifera*, Siebold et Zuccarini, var. *plumosa*, Beissner, *Nadelh.* 87 (1891).

A dense shrub or small tree, usually of conical habit; branchlet systems crowded, more or less overlapping, often curved at the distal end, bi-pinnate, with the pinnæ in one plane. Leaves crowded in decussate pairs, decurrent in their basal half, ⅛ in.

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[1] *Journ. Linn. Soc.* (*Bot.*) xviii. 490 (1881).

[2] Syme in *Gard. Chron.* xviii. 395 (1882). At the present day it often produces fruit, as at Kilmacurragh and elsewhere. Shepherd sent a specimen covered with cones from Wolverston Park to Dr. Masters. Cf. *Gard. Chron.* iv. 671 (1888).

[3] In *Gard. Chron.* xviii. 395 (1882).

[4] *Gartenflora*, xxix. 362 (1880), translated in *Gard. Chron.* xv. 333 (1881).

[5] *Proc. Roy. Hort. Soc.* xxxiv. p. ccxviii. (1909).

[6] Sargent, *Pinetum Wellesley*, 13 (1905), who says that the inability of the Japanese cypresses to flourish in the eastern United States for any length of time has been well shown at Wellesley, where of the several hundred individuals, in nearly all the obtainable varieties, that had been planted at different times, few have survived.

long, subulate, ending in a sharp cartilaginous point, slightly spreading, concave from side to side, and whitened on the inner surface.

This variety is known in Japan as *Shinobu-hiba*, and was introduced from there by J. Gould Veitch in 1861. It produces fruit[1] similar to that of the type, but smaller, as at Osborne, where it is 25 ft. high.

Syme[2] observed on this variety branches with the foliage of *C. pisifera*; and Beissner mentions a tree at Wilhelmshöhe, Cassel, the lower half of which is bushy and covered with foliage of var. *plumosa*, the upper half having the loose branches and foliage of *C. pisifera*.[3]

This variety is very hardy, and as a small plant is suitable for window boxes out-of-doors in winter.[4] During the severe frost of February 1882, the golden Retinisporas at Kew[5] lost many small branches; while those with green, glaucous, or silvery foliage remained uninjured.

Several coloured sub-varieties are known:—

Var. *plumosa albo-picta*. Tips of many of the branchlets pure white.

Var. *plumosa argentea*. Young branchlets creamy white, becoming green in the following spring.

Var. *plumosa aurea*. Young branchlets golden yellow, gradually changing to green as the season advances.

3. Var. *filifera*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 356 (1896).

*Retinispora filifera*, Standish, ex Gordon, *Pinetum*, 364 (1875); Syme, in *Gard. Chron.* v. 235, fig. 43 (1876).
*Thuya pisifera*, Masters, var. *filifera*, Masters, in *Journ. Linn. Soc.* (*Bot.*) xviii. 491, fig. 3 (1881).
*Chamæcyparis pisifera*, Siebold et Zuccarini, var. *filifera*, Beissner, *Nadelh.* 90 (1891).

A low tree, with spreading branches, and long pendulous branchlets, undivided for the greater part of their length, and terminating towards the end in bi-pinnate divisions. Leaves in decussate pairs, subulate, sharp-pointed, about $\frac{1}{8}$ in. long, decurrent in their basal half, concave and whitened on their inner surface.

This is known in Japan as *Hiyoku-hiba*, and was apparently introduced by Fortune into the Bagshot Nursery in 1861. There is a good specimen of this at Tortworth, bearing fruit exactly like that of the type. Planted at Osborne in 1873, it is now 15 ft. high and covered with small cones. Both Syme and Beissner mention cases in which branches reverted to the ordinary foliage of *C. pisifera*.

Sargent[6] says this is one of the most remarkable of pendulous conifers, but in New England it is very capricious, sometimes flourishing with great luxuriance, as in Mr. Hunnewell's pinetum at Wellesley, Massachusetts, but more often perishing from the cold of severe winters.

4. Var. *aurea*. Normal branching and foliage, the latter in the first year bright yellow, changing to green in the following year. This originated in Barron's nursery at Borrowash. (A. H.)

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[1] Masters, in *Gard. Chron.* iv. 671 (1888), mentions a tree at Canterbury of this variety, laden with cones of *C. pisifera*.

[2] In *Gard. Chron.* xviii. 395 (1882).

[3] Mr. Bartlett sent from Pencarrow to Dr. Masters a branch of var. *plumosa*, which was produced on a tree of *C. pisifera*, about eighteen years old. Cf. *Gard. Chron.* xxvii. 9 (1900). Elwes saw the same thing at Woodstock.

[4] *Gard. Chron.* xvi. 410 (1881).

[5] *Kew Bull.* 1896, p. 8.

[6] *Garden and Forest*, x. 431 (1897).

### DISTRIBUTION

This tree[1] has much the same distribution as *C. obtusa*, and is called *Sawara* in Japan. Where the two are mixed in natural forest it is usually the commoner, as it reproduces more freely from seed, and on account of the lower value of its timber is not so much felled except in places easy of access. Its habit of growth is more pendulous and graceful, and it attains about the same size as its congener. The largest that I measured in the Atera valley was by the roadside, and had its roots partially cut through. It appeared to be about 150 years old, and was 115 ft. by 13 ft.; but Mayr states that he saw, in a chestnut forest, a tree 120 ft. high and 3 ft. in diameter; and among beech and oak, another 130 ft. high and 3 ft. in diameter, whose first branch was at 80 ft. from the ground. The tallest he measured was 134 ft. high, and the thickest 7 ft. in diameter. On a stump recently cut in the forest of Atera I counted about 200 rings in a diameter of 4 ft., but the heart was rotten and the tree must have been 250 years or more old.

I saw no trees of the numerous varieties which are grown as pot plants in a dwarfed condition, but these do not seem to be so popular among the Japanese as among foreigners.

The timber, though fine in grain, is not so much valued, though used for the same purposes as that of *C. obtusa*. When the trees have died standing, it turns to a greyish colour, and a large slab of this wood which I brought home shows a very pretty grain.

### CULTIVATION

This species was introduced by J. Gould Veitch in 1861, and like *C. obtusa* has become widely spread in gardens, where it is usually seen as a small shrubby tree. It is perfectly hardy, and ripens seed freely in the warmer parts of England, but shows no signs of attaining timber dimensions in this country. It appears to grow slightly faster than *C. obtusa*, and like it dislikes lime in the soil.

The finest specimens that we have seen are:—at Bicton, 41 ft. by 4 ft. 10 in. in 1906 (Plate 305); at Canford Manor, Dorset, 40 ft. by 4 ft. 3 in. in 1906; at Moncrieffe, 38 ft. by 3 ft. 10 in. Smaller trees have been seen by us at Chatsworth, Killerton, Tortworth, Dropmore, High Canons (Herts), Golden Grove, Tan-y-bwlch, and Castle Kennedy.

This species is well adapted for hedges, as it bears pruning well, and by continual cutting acquires a very dense habit.

In New England[2] it is a more rapid-growing and perhaps a hardier tree than *C. obtusa*, but with its loose narrow crown of more upright branches is less ornamental than that species. It has attained 32 ft. high at Wellesley, Massachusetts.[3]

In Prussia[4] this cypress has been tried in thirteen experimental plots, covering five acres. It grows quicker than *C. obtusa* in youth, attaining in its fifth year a height of 2 to 5 ft., in its tenth year 7 to 10 ft., and in its fifteenth year 13 to 20 ft. It begins to bear fertile seed when about fourteen years old. It appears to be more hardy in Prussia than either *C. obtusa* or *C. Lawsoniana*. (H. J. E.)

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[1] It is unknown in the wild state out of Japan, and is not yet recorded for Formosa. We have not been able to find the specimen, collected in Yunnan by Anderson, referred to by Kent, Veitch's *Man. Conif.* 227, note (1900).

[2] Sargent, in *Garden and Forest*, x. 431 (1897).

[3] Sargent, *Pinetum Wellesley*, 13 (1905).

[4] Schwappach, *Anbauvers. fremd. Holzarten*, 30 (1901).

## CUPRESSUS NOOTKATENSIS, Sitka Cypress.

*Cupressus nootkatensis*, Don, in Lambert, *Genus Pinus*, ii. 18 (1824); Loudon, *Arb. et Frut. Brit.* iv. 2480 (1838); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 352 (1896); Sargent, *Silva N. Amer.* x. 115, t. 530 (1896); Kent, Veitch's *Man. Conif.* 217 (1900).

*Cupressus nutkaënsis*, Hooker, *Fl. Bor. Amer.* ii. 165 (1839); Murray, in Lawson, *Pinet. Brit.* ii. 199, t. 34 (1869).

*Cupressus americana*, Trautvetter, *Imag. Pl. Fl. Rossica*, 12, t. 7 (1844).

*Chamæcyparis nutkaënsis*, Spach, *Hist. Vég.* xi. 333 (1842); Syme, in *Gard. Chron.* xi. 560 (1879); Mayr, *Fremdländ. Wald- u. Parkbäume*, 276, t. 1. (1906).

*Chamæcyparis nootkatensis*, Sargent, *Trees N. Amer.* 83 (1905).

*Thuya excelsa*, Bongard, in *Mém. Acad. Sci. St. Pétersb.* ii. 164 (1833); Macoun, *Cat. Canad. Plants*, i. 461 (1883).

*Thujopsis borealis*, Carrière, *Conif.* 113 (1855); Lemaire, *Illust. Hort.* ii., *Misc.* 84 (1855).

A tree, attaining in America 120 ft. in height and 18 ft. in girth. Bark about $\frac{1}{2}$ in. thick, brownish grey, and separating on the surface into large thin loose scales. Branches of the fifth year smooth, terete, brown; those of the third and fourth year roughened with persistent brownish remote leaves. Branchlet systems distichous, on the upper part of the tree pendulous in vertical planes at right angles to the stem, tri-pinnate, with alternate pinnæ disposed in one plane. Ultimate branchlets flattened, compressed, $\frac{1}{15}$ in. wide. Leaves, $\frac{1}{8}$ to $\frac{1}{12}$ in. long, green, not marked with whitish lines or streaks, appressed; lateral pair conduplicate, acute and minutely mucronate at the spreading apex; facial pair flattened, rhomboidal, with an acute or mucronate apex, and a shining median ridge, often furrowed longitudinally. Leaves on the main axes equal in length, $\frac{1}{4}$ in. long, with acute free tips.

Staminate flowers yellow, $\frac{1}{8}$ in. long, with eight to twelve stamens. Pistillate flowers dark plum colour. Cones, ripening in the second year, and falling soon after the escape of the seed, on the ends of short leaf-clad branchlets, dark brown tinged with a glaucous plum colour, globose, $\frac{1}{3}$ in. in diameter; scales usually four, rarely six, bearing near their centre a prominent triangular sharp-pointed process, occasionally covered with resinous glands. Seeds two on each scale, flattened-pyriform, acute at the apex, reddish brown, without resin-vesicles; with the broad wings nearly $\frac{1}{4}$ in. wide.

Seedling:—Cotyledons two, $\frac{1}{3}$ in. long, sessile, linear, rounded at the apex. Primary leaves usually in whorls of fours, occasionally in pairs or threes, $\frac{1}{3}$ in. long, decurrent at the base, acute or acuminate at the apex, linear, green beneath with indistinct stomatic bands. The stem in the first year attains about an inch in height, developing about eight whorls of leaves and a tiny lateral branchlet, and ending in a tuft of smaller leaves. The tap-root is slender, flexuose, about 1½ in. long.

### VARIETIES

Scarcely any varieties have been noticed in the wild state. Under cultivation it has shown much less tendency to variation than *C. Lawsoniana.* The most notable varieties are:—

1. Var. *pendula*. Branches and branchlets very pendulous. Fine examples occur at Bayfordbury. Dr. Masters[1] figures a pendulous variety in a forest clearing in British Columbia.

2. Var. *lutea.* Young branchlets yellow, changing to a yellowish green when older. It is fast in growth and is similar in habit to the type.[2] At Powerscourt this variety is pendulous and remarkably beautiful.

3. Var. *glauca.* Leaves glaucous.

4. In var. *argenteo-variegata* some of the young branchlets are creamy white, while in var. *aureo-variegata* some are yellowish. There are good specimens of these at Highnam.

5. Dwarf forms are also known, as var. *compacta*, a shrubby form with crowded branchlets; and var. *gracilis*, with very slender branches.

6. Var. *nidifera*,[3] Rovelli, which originated at Pallanza, is said to be feathery-looking, owing to the slender shoots, densely covered with appressed deep green subulate leaves, each with a central gland on the back. (A. H.)

### DISTRIBUTION

According to Pinchot,[4] this species, which is universally known in its native habitat as yellow cedar, grows in the Pacific Coast region from the head of the Santiam river in the Cascade mountains of northern Oregon, northward through Washington, British Columbia, and Alaska to Prince William Sound.

It is most abundant, and reaches its best development, on the coast and adjacent islands of British Columbia and southern Alaska, where it often predominates in the forest. In Washington small stands, covering thirty or forty acres, sometimes yield as high as 150,000 board feet per acre.[4]

It occurs occasionally pure; but is usually scattered through the forests in British Columbia and Alaska, with Sitka spruce, giant Thuya, western hemlock, and swamp hardwoods; and at timber line occurs in a stunted form with Sitka spruce, black hemlock, and lodge-pole pine. Farther south on the coast it is associated with lowland fir and yew; while at higher elevations, in the Cascades, it is mixed with black hemlock, lodge-pole pine, *Abies amabilis* and *A. nobilis*, Douglas fir, western larch, white pine, alpine fir, and Engelmann's spruce. On the coast of Puget Sound this tree is not seen, as in this latitude it hardly extends to sea-level, though farther north, in Queen Charlotte Sound and Islands, it becomes one of the most common trees. In Vancouver Island[1] I did not see it, as it grows only at a higher elevation and farther north than I reached, and as yet forms no part of the produce of the lumber mills.

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[1] *Gard. Chron.* xl. 166, fig. 68 (1906).

[2] Figured by Earl Annesley, *Beautiful Trees*, 55 (1903).

[3] Cf. *Gard. Chron.* vii. 108 (1890).

[4] *U.S. Forest Service, Sylvical Leaflet*, No. 12 (1908).

In Washington it is found only in small areas, and is not abundant. Plummer says[2] that it is found between 2600 and 7400 ft., generally associated with mountain fir, pine, and hemlock, preferring shady valleys and basins, and not exceeding 100 ft. high by 3 ft. in diameter. But I found on the road from Longmire Springs to Paradise Valley, on Mt. Rainier, a tree of remarkable size, 108 ft. high and 17 ft. 10 in. in girth; above the point at six ft. where the tree forks just below this, it measured no less than 26 ft. in girth, and seemed quite sound. This appears to be the largest girth recorded for this species. Plate 306 from a photograph taken in this district, and Plate 307 from photographs taken in Washington, give a good idea of the habit of the tree in its native forests.

In Washington it crosses the Cascade mountains to the valleys running east, where Mr. Gorman found it from 2100 ft. on the Stehakin, to 6000 ft. about the headwaters of the Methow and Rattlesnake Creek. He says:[3]—"Of all the trees of this region the Alaska cedar is the most pronounced lover of moisture, and on this account it is not only confined to the moist valleys, but to those only which head in or about the main divide of the Cascade range. The finest specimens are in the Stehakin and Agnes Creek, where it ranges from 50 to 75 ft. high and 10 to 25 in. diameter. About its upper limits, especially in Horseshoe Basin, the tree was quite alpine in habit and very stunted in growth, but even the most stunted trees, some of which did not exceed 10 ft. in height, were found to be fairly well covered with the typical small barbed cones, which take three years to mature their seed.[4] The bark of the young tree is somewhat red and shreddy, becoming checked and grey with age, when it bears a strong resemblance to that of *Thuja plicata*; but the mature tree, unlike the latter, continues sound at the core."

## HISTORY AND CULTIVATION

The yellow cedar was discovered in 1793 by Archibald Menzies, who accompanied Vancouver, as surgeon and naturalist, in his voyage round the world. His specimens, gathered on the shore of Nootka Sound, were described by Don in 1824. It was first cultivated about 1850 in the St. Petersburgh Botanic Garden, whence it was sent out under the name of *Thujopsis Tschugatskoi*, Fischer;[1] and, soon after, it became known in France[2] under the name *Thujopsis borealis*, Carrière. It appears to have been first introduced[1] into England by Pontey, of Plymouth, who received plants from Booth, of Hamburg, which in 1854 were 3 ft. high.

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[1] According to Butters, in *Postelsia*, 199 (1906), it is common in the south-eastern part of Vancouver Island, at elevations above 1000 feet. Anderson, in *Canad. Forestry Convention Report*, 1906, p. 71, says the nearest point to Victoria where trees are found is on the Nanaimo River and on Mt. Benson; and adds that it grows in large quantities in the interior of the island, and extends to the snow-line.

[2] *21st Ann. Rep. Geol. Survey, Mount Rainier Forest Reserve* (1900).

[3] *19th Ann. Rep. Geol. Survey, Washington Forest Reserve*, 339 (1899).

[4] Pinchot, in *U.S. Sylvical Leaflet*, 12, p. 3 (1908), says: "Flowering takes place in April, and the seeds mature and are scattered in the early autumn of the same season. They are distributed by the wind, and though they will germinate on moss and decaying wood, mineral soil is preferred as a seed-bed." Sargent also states that the fruit ripens in the first season. Both, however, in America and in England, the seeds do not ripen till late in the spring of the second year, and the cones usually do not open until the autumn following.

Though not so generally planted, or so common, in gardens as Lawson cypress, it has been during the last fifty years a popular tree among nurserymen under its old name of *Thujopsis borealis*. Though looked on as an ornamental tree only, my experience of it on poor dry soil justifies me in thinking that, if it could be procured at a reasonable cost, it would be one of the most valuable trees for such soils that can be planted; because it is not only absolutely hardy[3] under all conditions in every part of the country, but will thrive where no other tree whose timber at all approaches it in value, except perhaps the larch, will grow to any size. Though a slow grower at first, and not likely to attain in this country the dimensions of *Thuja plicata*, it has all the other good qualities of that tree in an even greater degree. The difficulty of raising it from seed, which I and others have experienced, is one that I cannot yet explain, for though I have on several occasions sown carefully both imported seed and freshly gathered seeds saved from my own trees, I have never had more than a very small percentage of germination, the seeds mostly lying dormant for more than a year without losing their apparent freshness.

Mr. J. Rafn, of Copenhagen, whose tests of the germination of tree seeds have been published in the *Trans. Roy. Scot. Arb. Soc.* xvi. 277 (1900), informed me that his experience was similar.

In October 1905, I gathered a quantity of seed from my own trees, which had been produced in 1904, and seemed mature in the spring of 1905, though the cones remained closed till autumn. Part of this seed was sown under glass in boxes, part in a frame, and part in the open ground, as soon as it was dry; but the proportion which germinated in the following year was not 1 per cent. I was much surprised, therefore, when in the spring of 1907 the seed germinated regularly and well, a unique instance, in my experience, with seeds of this character when properly treated. I am however informed by Capt. the Hon. R. Coke, that he raised a considerable number of seedlings of this tree, by gathering the fruit in May, drying it in the sun, and sowing at once. In this case, the seed germinates in the succeeding spring, and so gains a year over autumn sowing.[4]

As it is easily propagated from cuttings, the plants sold in nurseries are usually so produced; and though I have the same preference for seedlings in this case as in others, I am not able to say from experience that cuttings will not make as good trees eventually.

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[1] Cf. Lindley, in *Gard. Chron.* 1854, p. 727, and 1856, p. 772, who says that the seeds were supposed to have come from "Tschukotsk, a cape on the west coast of Kamschatka."

[2] It was exhibited, as *Thujopsis borealis*, by Thibaut and Keteleer, at a horticultural meeting in Paris in 1852, and occurs in the list of plants cultivated in the Jardin des Plantes in 1853. Cf. *Gard. Chron.* 1854, p. 727. It was also called *Pinus Tschugatskoi* by French nurserymen. Cf. *Gard. Chron.* 1856, p. 342.

[3] In Palmer's frost-tables, quoted by Lawson, out of seventy-eight places from which he had reports of the effects of the severe winter of 1860-61, not one tree was killed, and only three were slightly injured.

[4] On 19th October 1909, I sowed a packet of seed freshly gathered at Bayfordbury, and kept the pot in a cold frame. On 10th April 1910, a large proportion of this seed had germinated. Messrs. B. Reid of Aberdeen also inform me that for the first time in their experience, seeds of this species have germinated in the next spring after sowing; so there is evidently some condition that we do not yet understand, which governs the germination of the seeds of this species.

I have rarely seen a sickly, diseased,[1] or frost-bitten tree of this species in England, and though on good soils I would prefer Lawson cypress, I have so much confidence in its ultimate value as a timber tree, that I would on my own soil plant ten thousand, if I could get that number of seedlings at anything like a forest tree price. It seems to grow equally well on limestone, clay, or sand, but I have no experience on peat. I have not observed any case of rabbits eating the bark of this tree.

In its native country the yellow cedar seems to grow best in a mild damp climate, where the rainfall ranges from 30 to 100 in. or more. It seems absolutely indifferent to any sudden changes, and endures the severest frosts, whether in winter, spring, or autumn, without the slightest injury.

Though it grows faster and larger on deep fertile well-drained soils, it seems to suffer less from drought on dry oolite soil than any of the trees which accompany it in its native country. It will grow, perhaps, better than any other western conifer on this soil. Six trees which I planted in 1876 or 1877 are now 35 ft. high by 2 ft. in girth, and very uniform in height and habit; whilst Corsican pines planted close to them at the same time are about 40 ft. It does not seem to respond to good soil so well as most trees; the largest that I know in England having made about the same rate of growth, namely, one foot per annum.

It has a narrow conical crown, a rapidly-tapering stem set with persistent, horizontal or slightly-drooping branches, and flattened pendent sprays of foliage. The branches do not seem to die, however closely the tree may be crowded, until it has attained considerable age. The root-system is comparatively shallow and fibrous, making the tree very easy to transplant in spring or autumn; and the percentage of death after transplantation on my soil is unusually small.

## Remarkable Trees

The largest that I have measured in England grows not far from the great Douglas fir at Eggesford, and in 1908 measured 61 ft. by 5 ft. 7 in., a tree of perfect shape with a very good trunk. At Killerton there is one of 52 ft. by 5 ft.

At Streatham Hall, near Exeter, there are many good trees growing on each side of the drive, which prove the fitness of this species for planting avenues of moderate width and length. At Tortworth there are two fine trees, one of which (Plate 308) is about 55 ft. by 4½ ft.; another, with a double leader, is about 50 ft. high. At Eastnor Castle there is one which Mr. Mullins reported in 1909 to be 57 ft. by 4½ ft.

At Leonardslee there is a well-shaped tree about 50 ft. high and only 3 ft. 8 in. in girth. At Hewell Grange there is a very thriving specimen 60 ft. high by 4 ft. 4 in. in girth. At Bayfordbury, in a drier soil and climate, there is a tree with such a graceful pendulous habit, and which has the rank disagreeable smell, usually possessed by this species, so faint, that I at first mistook it for *Cupressus funebris*.

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[1] In Germany, according to Unwin, *Future Forest Trees*, 96 (1905), it suffers more even than Lawson cypress, from a fungus, *Pestalozzia funerea*, which causes the decay of the bark of the young shoots.

At Shadwell Court, near Thetford, Henry measured a tree 58 ft. by 3 ft. 8 in., growing on poor sandy soil which contains lime.

In all parts of Scotland where I have seen it, especially in the west, this species grows well, and should be valuable, not only for ornament, but also for planting in rocky and exposed situations, though so far as we know it has not yet been planted under forest conditions. The largest that I have measured is a very healthy tree in the Dolphin Walk at Murthly, which, in 1906, was 45 ft. by 3 ft.[1] At Poltalloch, in the same year, I measured one of 42 ft. by 3½ ft.

In Ireland we have seen fine trees at many places, the largest perhaps at Woodstock, about 55 ft., the average rate of growth being about one foot per annum, though at Powerscourt it was 40 ft. high twenty-four years after being planted. Everywhere it seems to grow as well as in England, and to be worth planting more extensively.

In France and Germany the climate does not seem to suit it so well as in Great Britain, and we have seen no specimens of remarkable size. But a tree is reported[2] to be growing in the grounds of the Villa Lindenhof, at Lindau, on the Lake of Constance, which was no less than 30 metres high, though I suspect this to be a misprint, for I have found no other records at all approaching this. Pardé[3] states that it has produced natural seedlings at Auteuil (Oise), and that the plantations of it which he saw at Weinheim, in Baden, are superb. In Norway, Schübeler says, it is hardy as far north as Trondhjem, and grows well at Christiania and Stockholm.

## Timber

Of all the coniferous trees of North America, none has better wood than this, though it is little known even in its own country, on account of the difficulty of getting it in commercial sizes from the comparatively inaccessible places where it grows. Hough says that for cabinet-making it has few if any equals among North American woods, and that it has been exported to China in considerable quantities where it is used as a substitute for satin-wood. Though its lustre does not equal that of satin-wood, yet the section in Hough's book which was cut from a tree growing on Mt. Hood, Oregon, shows a remarkable density and slowness of growth. Hough counted 427 rings in a radius of 9¼ in. only; and I have never seen any coniferous wood so compact, or in which the rings are so hard to distinguish.

Ordinary commercial boards of much inferior quality to this were quoted in 1904 at Victoria, B.C., at 60 dollars per 1000 ft., or more than double the price of the finest Oregon fir or red cedar; and though, owing to this high price, it is little used except in the best houses, yet the work done with it in the house of the Hon. James Dunsmuir, Lieut.-Governor of British Columbia, proved to me that it was a wood which, if it could be procured in this country, would take a high rank among fancy woods for furniture, cabinet-making, and panelling.

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[1] In *Journ. Roy. Hort. Soc.* xiv. 533 (1892) a tree was reported here as 50 ft. by 1 ft. 9 inches, but this I could not find, and suspect a misprint. Another at Brahan Castle was said (*op. cit.* 541) to have been then 45 ft. by 6 ft. 8 in., which also seems doubtful.

[2] *Mitt. deut. dendr. Ges.* 1905, p. 32.

[3] *Arb. Nat. des Barres*, 39 (1906).

I do not find that the strong, and to most persons offensive smell, which is present in the leaves and bark of this tree, is noticed in the wood except when freshly planed, and this smell soon disappears after exposure.

A small importation of this wood which I recently purchased in Liverpool, has been tested by my house carpenter, who reports that it takes a finer surface and absorbs less polish than any soft wood he knows.

Mr. J. R. Anderson,[1] Deputy Minister of Agriculture in British Columbia, writes to me as follows, in reply to my inquiry as to this timber:—

"It is a grand wood, and you are quite right in designating it the finest of the N. American coniferous woods. It is a tree of slow growth, and therefore close grained. A specimen I have which was cut on the Nanaimo river, where it grew on good soil not far above sea-level, shows 137 rings for 13 in., that is at the rate of about 10 years to the inch, assuming that the rings represent a year's growth; and at high altitudes it is reasonable to expect a still slower growth. The soil that it affects is not what may be termed poor, but rather of a peaty cold nature, and in this latitude high up on the mountains. Two to four feet is a good size, and I have seen quite extensive groves at the base of Mount Arrowsmith, and elsewhere where the size is much less."

Mr. Anderson enclosed me a letter from Mr. C. Harrison, who states that yellow cedar claims were, in 1907, for disposal at 3½ dollars per acre, which would carry on an average about 12,000 ft. board measure to the acre, with a quantity of spruce and hemlock in addition. But the obligation to cut all timber within a few years which existed under the Government leases of timber lands in British Columbia, and which was described by one of the best authorities in Canada as insane, offers no inducement to any one to take up timber limits in the province, who has not the intention and the means to realise everything that can be got to market at a profit, and then abandon the land as quickly as possible.

## CUPRESSUS LAWSONIANA, Lawson Cypress

*Cupressus Lawsoniana*, Murray,[2] in *Edin. New Phil. Journ.* i. 292, t. 10 (1855); Hooker, in *Bot. Mag.* t. 5581 (1866); Murray, in Lawson, *Pinet. Brit.* ii. 191 (1866); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 353 (1896); Sargent, *Silva N. Amer.* x. 119, t. 531 (1896); Kent, Veitch's *Man. Conif.* 205 (1900).

*Cupressus fragrans*, Kellogg, in *Proc. Calif. Acad.* i. 103 (1857).

*Cupressus nutkanus*, Torrey, in *Bot. U.S. Explor. Exped. Wilkes*, ii. t. 16 (1874).

*Chamæcyparis Lawsoniana*, Parlatore, in *Ann. Mus. Stor. Nat. Fir.* i. 181 (1864); Sargent, *Trees N. Amer.* 84 (1905).

*Chamæcyparis Boursierii*, Carrière, *Conif.* 125 (1867) (not Decaisne).[3]

A tree attaining in Oregon about 200 ft. in height, and 6 to 12 ft. in diameter above the abruptly enlarged base. Bark on old trunks, 3 to 10 in. thick, reddish brown, with a dark compact inner thin layer, and a spongy outer thick layer, dividing on the surface into rounded ridges covered with small appressed scales; on young stems thin, slightly scaly, with narrow longitudinal fissures.

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[1] In *Canad. Forestry Convention Report for 1906*, p. 71, Anderson says that the strong but rather unpleasant odour is objectionable to insects. The Indians make canoes and carvings of the wood.

[2] This description is reprinted in *Gard. Chron.* 1855, p. 372.

[3] *Chamæcyparis Boursierii*, Decaisne, in *Bull. Soc. Bot. France*, i. 70 (1854), is *Juniperus occidentalis*, Hooker. Cf. *Gard. Chron.* xi. 726 (1879).

Branches of the fourth year slightly compressed, brown, with traces of the leaves. Branchlet systems disposed in planes tangential to the trunk of the tree, distichous, tri-pinnate, with the pinnæ in one plane. Ultimate branchlets flattened, compressed, about $\frac{1}{16}$ in. wide. Leaves appressed, usually marked on the under surface with ill-defined streaks of white, partly on the ventral leaf and partly on the lateral leaves; lateral pair conduplicate, $\frac{1}{12}$ to $\frac{1}{16}$ in. long, often minutely mucronate; facial pair rhomboidal, much smaller, $\frac{1}{20}$ in. long, acute, often marked with a glandular furrow or circular pit. Leaves on the main axes, oblong, unequal, the lateral pair $\frac{1}{4}$ in., the facial pair $\frac{1}{5}$ in. long, with acute or acuminate, slightly spreading apices.

Staminate flowers[1] crimson, the connectives usually bearing two anther-cells. Pistillate flowers plum-coloured, with horizontally spreading scales. Cones, ripening in the first autumn, globose, $\frac{1}{3}$ in. in diameter, reddish brown and covered with a glaucous bloom; scales eight, depressed in the centre and with an ovate acute reflexed process. Seeds, two to five on each scale, ovate, acute, $\frac{1}{8}$ in. long, brown, with conspicuous large resin-vesicles, and narrow wings.

The seedling[2] has two cotyledons, about $\frac{1}{3}$ in. long, broader and more rounded at the apex than in *C. nootkatensis.* Primary leaves arranged in whorls, as in that species, acuminate at the apex, $\frac{1}{5}$ in. long, conspicuously white beneath. The young plant attains 1 to 2 in. in height in the first year, frequently giving off two or three lateral branches, and has a very long slender flexuose tap root.

## VARIETIES

Hardly any tree has shown under cultivation so much variation as the Lawson cypress, no less than forty-eight varieties being mentioned in the *Kew Handlist of Coniferæ.*[3] The more important[4] may be arranged as follows:—

### I. *Columnar or fastigiate in habit.*

1. Var. *erecta viridis* (var. *stricta*). Narrow, erect, pyramidal, with a close dense mass of branches, all set with their foliage-bearing ramifications in planes radially disposed to the main stem. Foliage bright green. This originated[5] in Waterer's nursery at Knap Hill as a seedling, which was raised from seed imported from California in 1855. It was propagated and sold for some time as var. *erecta*, but in

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[1] Masters describes in *Journ. Linn. Soc.* (*Bot.*) xxvii. 312, fig. 19 (1890), an androgynous flower, the lower scales bearing anthers and the upper scales bearing ovules.

[2] Trees often produce seed abundantly when only 6 to 12 ft. high; and plants were raised from seed of very small trees in England as early as 1863 by W. Tillery. Cf. *Gard. Chron.*, 1864, p. 1013. Barron, in *Gard. Chron.*, 1861, p. 718, gives an instance of plants only 2 ft. high bearing cones.

[3] Beissner, in the second edition of his *Handbuch* (1909), describes 77 named forms, many of which seem to be hardly worth notice.

[4] Var. *fragrans*, kept up in the *Kew Handlist*, differs in no respect from the type, and appears from Gordon, *Pinetum*, 88 (1875), to have been sent out by Standish, and possibly may have been raised from seeds sent by Beardsley. See *infra*, p. 1206, note 1.

[5] Cf. *Gard. Chron.*, 1870, pp. 249, 279, fig. 49; and 1874, ii. 329.

1870, when the original plant was 9 ft. high, it obtained a first-class certificate at a meeting of the Royal Horticultural Society, and was renamed *erecta viridis*. It is quite unique as regards beauty, and never needs pruning or cutting; but snow or even heavy rain will bend and break the branches, which never recover, leaving unsightly hollows in its outline. It is most useful as a small decorative plant; but in some places has succeeded as a walk or avenue tree, and at Terling Place, Essex, has attained 30 ft. in height. It is perfectly hardy, even in the south of Norway. This has been largely planted in many places, the tallest that we have seen being at Bowood, where it is 43 ft. high. At Westonbirt and at The Hendre there are fine specimens 35 to 40 ft. high. At Baron's Court, Co. Tyrone, the seat of the Duke of Abercorn, there are several good specimens about 25 ft. high, planted about forty years ago, which, like most of the older trees of this variety, have become bare at the base on the north side.

2. Var. *Allumi* (var. *Fraseri*). Similar to var. *erecta viridis* in habit, but bluish in colour, due to the presence of a glaucous bloom on the leaves. Sir Herbert Maxwell tells us that this variety has come true from seed.

3. Var. *erecta filiformis*.[1] Similar to var. *erecta viridis* in habit, but with very slender branches and branchlets.

4. Var. *ericoides*. Branchlets very slender; leaves bright green, free and spreading at the apex.

5. Var. *Smithii* is columnar in habit, being nearly the same in diameter at the top as it is at the base. The foliage is glaucous.

6. Var. *Wisseli*[1] is also columnar in habit, with erect crowded branches and branchlets. The leaves are said to be juvenile in character, subulate, and spreading, with a glaucous tint; but in an example at Kew they are only slightly more spreading than in the type.

II. *Pendulous in habit*.

7. Var. *gracilis*. This name may be given to varieties with slender pendulous branches, the original form[2] of which originated in Waterer's nursery at Knap Hill, and received a first-class certificate from the Royal Horticultural Society in 1870. A more pendulous form, var. *gracilis pendula*, originated in Barron's nursery, Borrowash, Derby. In var. *gracilis aurea*[3] all the branches are similarly pendulous, but the growths of the current season are golden yellow in spring, changing to bright green in autumn, and to dark green in the succeeding year. A pendulous variety with white foliage, var. *pendula alba*, raised by Paul and Son, obtained[4] a first-class certificate at a meeting of the Royal Horticultural Society in 1869. At Little and Ballantyne's nursery, Carlisle, there is a peculiar pendulous variety, about 8 ft. high, resembling in form the weeping variety of *Sequoia gigantea*.

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[1] Cf. *Gard. Chron.* xxv. 116 (1899).

[2] *Gard. Chron.*, 1870, p. 249.

[3] The original plant was raised in the Hillsborough Nursery, Co. Down, and was purchased by the late Earl Annesley, *Gard. Chron.* xvi. 192 (1894). It was very beautiful in colour when I saw it in July 1907.

[4] *Gard. Chron.*, 1869, p. 1067.

III. *Spreading in habit.*

8. Var. *intertexta.* A robust plant, with distinct and arching branches, and remote stout divaricate branchlets. Foliage slightly glaucous or bluish green.[1]

9. Var. *juniperina.* Branchlets regularly pinnate, the ultimate divisions slender, with the leaves free at their apices, and yellowish green in colour.

10. Var. *patula.* Of pyramidal compact habit, with the branchlets very slender and forming fan-shaped expansions; leaves dark green, shining.

11. Var. *Youngi*, Masters, in *Gard. Chron.* i. 176 (1887). Of elongated pyramidal habit, with ascending, loosely-arranged, more or less concave and twisted branches.

12. Var. *filifera.* Branches spreading or sub-pendulous; the terminal branchlets being very long, with short remote lateral branchlets. There are good examples of this peculiar variety at Grayswood, Haslemere, and at Brickendon Grange, Herts.

IV. *Dwarf in habit.*

13. Var. *nana.* This includes the dwarf varieties, the original form having been obtained[2] in 1861 by Dauvesse. It is ovoid in shape, with stiff erect flattened branches and branchlets, and seldom exceeds 3 ft. in height. There is, however, a specimen at Westonbirt, said to be forty years old, which is about 7 ft. high. There are two distinct forms, one bluish green, which is the best, and another light green. Coloured dwarf varieties are also known as var. *nana alba*, with yellowish white foliage, and var. *nana glauca*, with very glaucous foliage.

V. *Coloured varieties.*

14. Var. *albo-spica.* Densely pyramidal in habit; terminal branchlets variegated with creamy-white. Forms known as *albo-maculata*, *albo-picta*, and *argenteo-variegata*, are very similar, if not identical, with this variety. The best example that we have seen of this is at Inverary, where it measured about 30 ft. in 1908.

15. Var. *argentea* (var. *glauca*). Foliage very glaucous, varying from almost a silvery white to steel blue. The forms known as "Silver Queen" and "Triomphe de Boskoop"[3] are similar, but differ somewhat in their degree of glaucescence. The latter is said to be the bluest conifer known. Other glaucous forms known as var. *Bowleri* and var. *californica* are in cultivation at Kew.

16. Var. *albo-variegata.* A dwarf compact variety, with the foliage profusely spotted and blotched with white. This originated in the Coombe Wood Nursery.

17. Var. *aurea.* Foliage golden yellow in the spring and summer of the first year, greenish yellow in autumn and winter following, becoming green in the second year. This is one of the best and most vigorous golden conifers for formal gardens and lawns, and has been largely planted at Baron's Court, where it forms a number of round compact bushes about 15 ft. high and as much in diameter. It requires exposure to full sunlight to bring it to perfection. It was shown by Waterer[4]

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[1] A MS. note of Dr. Masters says that this was the form which first appeared in cultivation at Lawson's nursery.

[2] *Gard. Chron.*, 1864, p. 579. In the King's Acre Nursery, Hereford, a dwarf bright green variety, known as var. *pygmea*, is only 3 ft. high after twenty-four years' growth.

[3] Cf. *Gard. Chron.* xxv. 116 (1899).

[4] *Gard. Chron.*, 1870, p. 315.

at a meeting of the Royal Horticultural Society in 1870, and obtained a first-class certificate.

18. Var. *lutea.*[1] Paler yellow in colour, but equally fine, and of a more erect habit. About the best that we have seen is a tree now about 25 ft. high at Castlewellan.[2] Var. *ochroleuca* appears to be another yellowish variety.

### DISTRIBUTION

The Lawson cypress in its distribution occupies a much smaller area than *Thuya plicata*, with which it mingles at its northern limit, and which it entirely resembles in its occurrence as a shade-bearer in the mixed coniferous forest of western North America at low altitudes. It grows in south-western Oregon and north-western California, in a climate characterised by moderate temperatures, heavy rainfall, a high degree of humidity, a foggy atmosphere, and a large proportion of cloudy days. On the coast the temperature ranges between 10° and 95° Fahr., and the rainfall between 30 and 100 in., averaging 56 in. Increase in altitude is attended by greater seasonal and daily ranges of temperature, and by an increase in snowfall; but the Lawson cypress, usually growing below 3000 ft. (rarely reaching 5000 ft.), is only luxuriant and plentiful in the region under the influence of the ocean winds.

In Oregon it reaches its northern limit on Coos Bay, and is most abundant in Coos and Curry counties on the western slopes of the foothills of the coast range.[3] It extends across the coast range to Camas valley in Douglas County, twenty-six miles south-west of Roseburg, and goes farther inland in Josephine County, extending to Love's Station, sixteen miles west of Grant's Pass, and to Selma and Waldo; while it appears to be scattered throughout the Siskiyou mountains between Oregon and California. In California it extends southward as an unimportant component of the Redwood belt on the coast as far south as Humboldt County,[4] and attains its most inland point (a hundred miles from the coast) on the southern slopes of Mount Shasta, at the headwaters of the Sacramento river.

This cypress nowhere forms pure woods, but is always scattered through the forest singly or in small groups, though near Port Orford it is very abundant, and in some places forms 25 per cent of the mixed forest of Douglas fir, Sitka spruce, hemlock, and Thuya. At Coquille, the most northerly point where I saw this species, it occurs on the slopes of the low hills, on which there is a luxuriant forest of enormous trees of several species, with a dense underwood of *Acer circinatum* and tall fern (*Aspidium munitum*), forming a scene like that of the Redwood belt in California. Here the Lawson cypress is most prized on account of its superior timber; but it is surpassed both in size and numbers by the Douglas and Thuya, which attain 250 to 300 ft. in height and 20 to 30 ft. in girth, while the largest cypress that I measured was[1] only 200 ft. by 14 ft. 6 in. A tree which had been felled had a diameter, exclusive of bark, of 44 in., and showed 220 annual rings, with 2½ in. of sapwood, containing thirty-three rings.

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[1] Mentioned as an entirely new plant in *Gard. Chron.*, 1873, p. 6.

[2] Figured by Earl Annesley, *Beautiful Trees*, 52 (1903).

[3] Sargent in *Gard. Chron.* xvi. 8 (1881), estimated that the belt in which this tree occurs most abundantly from north of the mouth of the Coquille river southward, about twenty miles long and twelve miles wide, contained 200,000 million feet, board measure, and speaks of the immense destruction of Port Orford cedar by a forest fire some years previously, which raged for three months in the vicinity of Coos Bay.

[4] Mr. Henry Melde of Eureka says that trees 75 to 100 ft. high occur along the gulches of the Mad river in Humboldt County (*Erythea*, v. 99 (1897)).

I saw a great deal of this species on my way by stage-coach from Grant's Pass, on the railway, through the Siskiyou mountains to the Redwood belt on the coast of California at Crescent City. Here it follows the course of the streams up to 3000 ft., growing in company with Douglas fir and other species in shady ravines, and attaining about 120 ft. in height and 3 ft. in diameter. On the dry hills it is immediately replaced by *Libocedrus decurrens*, though Pinchot says it is occasionally found on dry and sunny exposures in company with *Pinus ponderosa* and *P. Lambertiana.* Both here and at Coquille I saw numerous seedlings, less numerous but very uniform in appearance, in the shade of the parent tree in the forest; while they were excessively common on clearings and on agricultural land on the outskirts of the forest, and showed great variation when they were exposed to sunlight in youth. They grow most freely on mossy banks, rooting between the crevices. In the Redwood belt I saw cypress trees only on the banks of wide streams, where they are much smaller in stature and girth than the immense redwoods behind them. Pinchot says, however, that this species grows well in the north-west of California in swampy situations near the sea, associated with Sitka spruce, *Abies grandis*, and hemlock, but rarely forming a considerable part of the forest.

In Oregon close to the coast it thrives on sandy soil, and grows even on the sand dunes within reach of the spray of the ocean. In this State it has to compete with *Thuya plicata* in the moister deeper soil, as the latter species tends to outgrow and suppress it. In the forest it has a straight cylindrical stem, free of branches for half its height, with a slender drooping leader, which is bent away from the direction of the prevailing wind. It begins to bear seed when six to twelve years old, continuing annually in profusion to an advanced age. This abundance of seed enables it to spring up readily on logged-over and burnt areas. Seedlings in Oregon 5 ft. high showed ten annual rings. It occasionally is seen with a double stem; but, as a rule, it repairs its leader readily, which is, however, rarely injured except high up in the mountains when there is a heavy snowfall. It differs from all the other cypresses in its remarkably thick bark, which in its structure of two layers resembles that of the redwood. (A. H.)

## CULTIVATION

William Murray first sent seeds of this tree from the valley of the upper Sacramento river in California to Lawson's nursery at Edinburgh in 1854, but only four plants were raised, of which one growing at this nursery was 11 ft. 2 in. high in 1865, and is figured in *Pinetum Britannicum*, p. 194. In 1855[1] a larger supply of seed was sent by the same collector, and it soon became one of the most popular and generally cultivated trees all over Great Britain, where it is seen in almost every villa garden; but its value as a forest tree has been almost lost sight of. It yields seed[2] profusely at a very early age, and develops so many varieties of size, habit, and colour that it is hardly possible to believe that they have all had a common origin. The usual manner of propagation adopted by nurserymen is by cuttings, which are easily struck, and reproduce the different named varieties which are most admired; but if it is desired to plant the tree in a situation where it will have room to develop its natural size and habit, it is far better to gather seed from the tallest and most clean-stemmed trees, and select from the seedlings those which follow their parent most closely.

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[1] Sargent, Pinchot, and Mayr all agree in giving 200 ft. in height and 12 ft. in diameter as the maximum measurements of the Lawson cypress, but I doubt if it ever exceeds 7 ft. in diameter. The Douglas fir, Redwood, and Thuya, wherever they are associated with the Lawson cypress, much surpass it both in height and girth. Sir Victor Brooke, quoted by Lord Annesley in *Beautiful Trees*, 8 (1903), states that he measured a Lawson cypress 66 ft. 11 in. in girth, but he evidently refers to *Thuya plicata*, as there is nothing in his diary to show that he was ever in the region where the Lawson cypress grows.

Self-sown seedlings of this tree are found in many places where the soil and shelter are suitable, but of the millions of good seeds which must be shed annually, only a very small proportion succeed in passing through their delicate first stage. It is best to sow the seeds in a box, and keep them shaded and watered in a frame for a year or two. I have seen a self-sown seedling at Penllergare, near Swansea, 30 ft. high, which Sir John Llewellyn thought to be about as many years old.

The seedlings can be raised as cheaply as spruce, and much more so than silver fir. They grow fast and vigorously after the first two years on almost any soil, and are very easy to transplant in autumn or spring, though for cold localities I prefer September. Large plants should not be used in exposed situations, as on account of their dense foliage they are apt to be swayed by the wind.

It is perhaps premature to say that this is a valuable forest tree, for it has not been long enough in Europe to show whether it will grow to a really large size; and has seldom been planted closely enough together, or in situations where it has had a fair chance to show its capacity for forming a fairly clean trunk.

Its hardiness is astonishing, as in the greater part of the native habitat the climate is mild and damp, and severe frosts are unknown; and yet in Murray's[3] own words: "So far as is yet known there is not a hardier plant in Britain. Exposed in the winter of 1860-61 to the extremest cold which has visited this country in the memory of the present generation, it remained as green and fresh in the greatest frost and most exposed and unfavourable districts as in the midst of summer. Mr. Palmer's tables give only two slightly injured out of seventy-nine reported on." This was written about 1865, and has been amply confirmed by later experience.[4]

As regards soil it is equally accommodating, for though like all other trees it enjoys a good fertile loam, it will grow on dry sandy and on poor limestone soils, a cold and wet peat being, according to Kent, the only one unfavourable to it.[1]

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[1] Beardsley found this tree near Empire City on Coos Bay in 1855, and Kellogg described his specimens as *C. fragrans* in 1857. Plants cultivated under the latter name are identical with *C. Lawsoniana.* Cf. *Gard. Chron.*, 1869, p. 252.

[2] Unwin, *Future Forest Trees*, 94 (1905), states that a pint of seed weighs $\frac{1}{3}$ lb., and contains nearly 300,000 seeds. Of seed raised in the forest district of Freising near Munich, 70 per cent germinated.

[3] In Lawson, *Pinet. Brit.* ii. 193 (1866).

[4] Masters, in *Journ. Roy. Hort. Soc.* xix. 433 (1896), says that the young growths of Lawson's cypress suffered in the vicinity of London from the abnormal frost of February 1895 as they had never before been observed to do. Var. *erecta viridis* was much more injured than the ordinary spreading forms.

It is not, so far as we know, subject to any fungoid disease in this country.

It endures heavy shade and requires close planting to keep its trunk free from large branches. It has a tendency to fork, especially when grown from cuttings. Judging from what I have seen, the beech will probably be its best nurse, though on damper ground alder might be preferable, and I should expect it to be one of the best evergreens to use for under-planting, or filling up gaps in thin woods. In Earl Bathurst's park at Cirencester a large number were planted on the edge of one of the broad grass drives leading west from the "Ten Rides," and these, surrounded and shaded by beech trees, have grown to be over 60 ft. high in about fifty years or less, and for the most part have trunks which are much less branchy than spruce or silver fir would be in similar conditions. These trees are growing on thin dry oolite soil not more than 6 to 8 in. deep, and as Mr. R. Anderson tells me were planted in 1864. The average height of twelve of them in January 1909 was 55 ft., and the average girth 3 ft. If we estimate their cubic contents at about 10 ft. each, one might reasonably expect to grow on this land 200 to the acre, giving 2000 cubic feet per acre in fifty years. Our Plate 98, of Larches, near the Woodhouse in the same park, shows trees under similar conditions.

For avenues, Lawson cypress seems very suitable, provided that trees of uniform habit and equal growth are selected, and for this purpose they should be frequently transplanted before their final selection, as in the nursery some vigorous trees generally take the lead and keep it, whilst others remain comparatively dwarfish.

As a cheap and ornamental hedge plant it has many advantages. Its shade of green is more agreeable than any other evergreen used for this purpose, and its feathery branchlets are more graceful than the rigid shoots of the holly or yew. According to a writer in *Woods and Forests,* small plants, 18 in. to 4 ft. high, should be used for this purpose, as they can be clipped and headed back until they become dense at the base. They may be planted, 12 to 18 in. apart, according to the size of the plants. Such hedges are best clipped in early September.

In the eastern United States, Lawson cypress thrives from New York southwards; but in New England it merely survives in sheltered situations, and Sargent[2] says that it cannot be used for general planting.

In Germany[3] Lawson cypress has been tried in forest plots at different stations in Prussia, the total area being about thirty acres, and at Grafrath in Bavaria. Judging from an experience of twenty years, the wood grown in Germany is as good as that of Oregon. Heartwood begins to form in the tenth year with the characteristic fragrant odour of the timber in America. Trees, which had succumbed to the worst enemy of this species, *Agaricus melleus,* were successfully used for palings, without removing the bark. Another fungoid disease, *Pestalozzia funerea,* has proved disastrous to many plantations in Germany. This attacks the young branchlets, and is readily recognised by the appearance of a white resinous drop, by the decay of a band of bark, and by a characteristic swelling in the part of the branchlet beyond, which continues to grow for a time. Mayr says that after a severe frost in April, when the temperature fell to 10° Fahr., Lawson cypress at Grafrath was attacked by *P. funerea*, which, however, killed only the weakly trees, the stronger plants surviving. Mayr recommends close planting, about 3 ft. apart, in mixture with light-loving deciduous trees; and gives a picture of a plot where oaks thirty-five years old had been underplanted successfully twenty years ago with Lawson cypress.

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[1] It grows, however, on deep bog at Churchill, Armagh, where it had been planted with Scots pine and birch, and numerous natural seedlings sprang up which were used for transplanting on other parts of the estate.—(A. H.)

[2] *Garden and Forest,* x. 430 (1897).

[3] Cf. Schwappach, *Anbauversuche fremdl. Holzarten,* 26 (1901); Mayr, *Wald.- u. Parkbäume,* 272, fig. 74 (1906); and Unwin, *Future Forest Trees,* 93, fig. 2 (1905).

### REMARKABLE TREES

There are many specimens of this tree all over Great Britain from 50 to 60 ft. high; but it is difficult to select the finest. The tallest that I have measured in England is one at Eggesford, which in 1908 was 70 ft. by 5¾ ft. At Killerton two of very different habit stand together on the slope behind the house (fig. 309), and measured in 1906 about 65 ft. by 6 ft.

At Brickendon Grange, Herts, there is a beautiful avenue, 100 yds. long and 8 ft. wide, of this tree, planted 8 ft. apart in the line; and an average specimen measured in 1907, 52 ft. high and 2½ ft. in girth. At Ryston Hall, Downham, Norfolk, there is another fine avenue.

At Canford Manor, the seat of Lord Wimborne in Dorsetshire, I measured in 1906 a fine specimen, said to have been planted about forty years ago, which was 53 ft. by 6 ft.; and at Belvoir Castle one of about the same age was 56½ ft. by 4 ft. 10 in. in 1908.

At Leaton Knolls near Shrewsbury, the seat of Major Lloyd, there is a very handsome tree 59 ft. by 4 ft. 4 in.; and at Willey Park, the seat of Lord Forester, near Broseley, a slender tree is 59 ft. by 3 ft. 9 in.

In south Wales the tree grows everywhere very vigorously, the tallest I have seen being a slender tree crowded in the pinetum at Singleton Abbey, the seat of Lord Swansea, which, in 1907, was about 75 ft. by 3½ ft. At Penrhyn Castle and elsewhere in north Wales there are many fine trees.

In Scotland the tree is as common as in England, every place where conifers have been planted having some fine examples, but at Murthly there are more and bigger ones than I have seen elsewhere. In a flat below the castle, a lawn, measuring 50 yds. by 25 yds., has been surrounded with fine trees nearly 50 ft. high, very uniform in habit, whose branches now touch each other and form a dense enclosure.

At Dupplin Castle, near Perth, there are fine trees, one[1] of which was 55 ft. high in 1891, and is probably now the tallest in Scotland; and at Moncrieffe House there are some nearly as large. At Shanbally, Dumfries, Henry measured in 1904 a tree 60 ft. by 8 ft. 5 in. at 3 ft., dividing above into three stems; and at Benmore, where the tree has been largely planted, it seems to enjoy the very wet climate as much as *Thuya plicata*.

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[1] Malcom Dunn, in *Journ. Roy. Hort. Soc.* xiv. 89 (1892), who reports a tree of similar height at Rossie Priory.

In Ireland this species is, if possible, even more vigorous than in Scotland, and certainly grows faster. A tree at Kilmacurragh, Co. Wicklow, was reported[1] in 1906 as being about 80 ft. high, but the tallest that I could find when I was there in 1908, and which I believe to be the same tree, was only 60 ft. by 6 ft. There are three very fine ones in a group in the valley west of Castlewellan, of which the late Lord Annesley took a photograph (Plate 310) at my request shortly before his death. Though I was unable to measure them accurately, I believe they are well over 60 ft. high, and a tree in his garden which forms the first illustration in his book, measured 62 ft. high in 1903.

## TIMBER

Though this splendid timber has long been known and valued in Oregon and California, where it is second in value only to that of *Cupressus nootkatensis*, it does not appear to be known in European commerce. Sargent describes it as light, hard, strong, and very close-grained, abounding in fragrant resin, very durable in contact with the soil, easily worked and capable of taking a good polish. All these good qualities are well shown by some boards of this wood which I purchased in San Francisco, and which have been used for lining a wardrobe made for me by Messrs. Emanuel of London, who considered it one of the nicest woods for the purpose they had ever seen. The scent is extremely fragrant and persistent, so that linen kept in this wardrobe comes out with an odour more agreeable and delicate than that of camphor wood; but this scent is not present in a sample brought by Henry from Myrtle Creek, Oregon, which I believe to be taken from a tree long dead. This gives it a great advantage over the wood of *C. nootkatensis* for all inside work; and if selected and sawn from the butts of old trees, which show some figure, it would be very handsome wood for decorative purposes.

Mr. L. J. Simpson, manager of the Simpson Lumber Co. at North Bend, Oregon, whose mills are near the forest of this tree in Coos County, writes to me as follows:—"We have cut many logs of white cedar which are 6 to 8 ft. in diameter. Some of them get hollow at heart after attaining a great age, but this is very much less frequent than it is in red cedar or redwood. I enclose you a photograph of a spruce tree 7½ ft. in diameter, which has grown on the fallen stem of a smaller white cedar, the roots extending like the claws of a parrot around each side of the tree, and locking together underneath. The spruce tree must be over 200 years old, and the white cedar is to-day as sound as any of the green standing trees near it. You will notice in this photograph that the moss and dead leaves which have accumulated on the fallen log have been scraped away to show the soundness of the wood."

The Simpson Lumber Co. state in their circular that vessels built of this wood on Coos Bay over forty years ago are still as sound as when launched, the essential oil in the wood seeming to act as a preservative; and the smell is stated to be an absolute safeguard against moths when used for chests, presses, or wardrobes.

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[1] *Gard. Chron.* xl. 351 (1906).

They also say that the trees are usually sound and free from hollow butts, and produce a large proportion of lumber free from knots.

Mayr[1] states that each species of the cypress family, including Thuya, etc., has a wood recognisable by a special odour, that of *C. nootkatensis* being the strongest and most disagreeable. The wood of Lawson cypress, he adds, is so strongly aromatic, that it can easily be smelt on approaching a saw-mill where it is being cut up, and many pieces of the wood are so saturated with an oily resin that they become heavy and reddish in colour. He speaks of the durability of the wood in the highest terms, saying that, when used as piles for building in swampy ground near the sea-coast, it lasts four or five times as long as that of Douglas fir.

The trees in this country are as yet too young and mostly too branchy to show how soon these good qualities will be developed, but I have no doubt that in time it will be one of our most valuable home-grown timbers. (H. J. E.)

## CUPRESSUS THYOIDES

*Cupressus thyoides*, Linnæus, *Sp. Plant.* ii. 1003 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2475 (1838); Masters, in *Journ. Linn. Soc.* (*Bot.*) xxxi. 352 (1896); Sargent, *Silva N. Amer.* x. 111, t. 529 (1896); Kent, Veitch's *Man. Conif.* 231 (1900).

*Chamæcyparis sphæroidea*, Spach, *Hist. Veg. Phaner.* xi. 331 (1842).

*Chamæcyparis thyoides*, Britton, Steens, and Poggenburg, in *Prel. Cat. New York*, 71 (1888); Sargent, in *Garden and Forest*, ii. 484 (1889), and *Trees N. Amer.* 82 (1905).

*Thuya sphæroidalis*, Richard, *Mém. Conif.* 45 (1826).

*Thuya sphæroidea*, Sprengel, *Syst.* iii. 889 (1826).

A tree, attaining in New England 50 ft. in height and 2 ft. in diameter, and in the south-eastern United States 80 ft. high and 4 ft. in diameter. Bark, an inch thick, reddish brown, irregularly divided into narrow flat connected scaly ridges, which are often spirally twisted around the stem. Branches of the sixth year very slender, terete, brown, smooth, but retaining traces of the leaves, which roughen with their brown acute spreading tips the branchlets of the third, fourth, and fifth years. Branchlet systems alternate,[2] somewhat umbellate or radiating, forming short erect wedge-shaped expansions, tri-pinnate, with the pinnæ more or less in one plane and often directed to one side. Ultimate branchlets flattened, $\frac{1}{30}$ in. wide. Leaves, $\frac{1}{16}$ to $\frac{1}{12}$ in. long, glaucous green, and not marked with whitish lines or streaks; lateral pairs conduplicate, with mucronate spreading tips; facial pairs appressed, ovate-triangular, acute, flat or keeled; most of the leaves marked on the back with a conspicuous raised circular resinous gland. Leaves on the main axes, equal in length, glandular, $\frac{1}{6}$ in. long, oblong, with a triangular mucronate spreading tip.

Staminate flowers minute, dark brown, with five or six pairs of stamens. Pistillate flowers with ovate acute spreading dark brown scales, and black ovules.

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[1] *Waldungen N.-Amer.* 318 (1890).

[2] The peculiar branching of this species is described by Masters, in *Journ. Linn. Soc.* (*Bot.*) xxvii. 288 (1890).

Cones ripening in the autumn of the first year, globose, $\frac{1}{4}$ in. in diameter, on the end of a short scaly branchlet, bluish purple and covered with a glaucous bloom when ripe, ultimately reddish brown; scales six, each with an ovate acute, often reflexed central process. Seeds one or two on each scale, $\frac{1}{10}$ in. long, ovate, brown, without resin-vesicles, and with narrow wings. Cotyledons two.

### VARIETIES

This species appears to show little or no variation in the wild state. Under cultivation a number of peculiar forms have arisen:—

1. Var. *leptoclada*, Kent, Veitch's *Man. Conif.* 232 (1900).

Var. *andelyensis*, Carrière, *Conif.* 123 (1867).
*Retinispora leptoclada*, Gordon, *Pinetum Suppl.* 91 (1862).
*Retinispora andelyensis*, Carrière, in *Rev. Hort.* 1880, p. 36, figs. 4, 8.
*Chamæcyparis leptoclada*, Henkel and Hochstetter, *Syn. Nadelh.* 257 (1865).

A shrub with close-set branches, terminating in flattened branchlet systems, bearing partly adult foliage and partly primordial acicular leaves, which soon tend to disappear. This originated in M. Cauchois's nursery at Andelys (Eure) about 1850, and the plants were, in 1861, put on the market by Messrs. Henderson and Co., of the Wellington Nursery, St. John's Wood. This shrub produces fruit freely, and according to Carrière comes true from seed.[1] It is cultivated for sale at Rogers's nursery near Southampton, but is such a slow grower, that it is not much in favour, and seems to be less hardy than the type.

2. Var. *ericoides*, Beissner, *Nadelholzkunde*, 67 (1891).

A small dense pyramidal bush, with spreading subulate primordial leaves, glaucous in colour, but turning bronze or purplish brown in winter. This is supposed to be a juvenile form of *C. thyoides*; but its origin is doubtful, and by different authors it has been called a Cupressus, a Juniperus, a Retinispora, a Frenela, and a Widdringtonia.[2]

3. Var. *glauca*, Endlicher, *Syn. Conif.* 62 (1847). Occasionally known as var. *kewensis*. A shrubby form with glaucous foliage.

4. Var. *nana*, Endlicher, *Syn. Conif.* 62 (1847).

A dwarf bluish form, forming a small rounded bush.

5. Var. *Hoveyi*, a slender form with short ultimate branchlets, forming dense terminal tufts.

6. Var. *variegata*, Endlicher, *Syn. Conif.* 62 (1847).

Leaves yellowish. Loudon mentions a variegated form which was received at Chiswick from the Dunganstown Nursery in Ireland about 1831.

### DISTRIBUTION

This tree grows mainly in maritime swamps in the Atlantic and Gulf states, which are liable to be overflowed by the sea during several months of the year.

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[1] This is confirmed by Mr. Paul. Cf. *Proc. Roy. Hort. Soc.* xxxiv. p. ccxix. (1909).

[2] Cf. Sargent, in *Garden and Forest*, x. 430 (1897). It is probably the same as *Retinispora pseudosquarrosa*, Carrière, *Conif.* 140 (1867), and in *Rev. Hort.*, 1880, p. 96, who says it was obtained at Le Mans in 1840 by M. Bergeot from a seed of *C. thyoides*.

It extends from southern Maine to northern Florida, and westward to Pearl River, Mississippi, forming pure forests in the north, and mingling with deciduous cypress and other moisture-loving species in the south. It is confined in Maine to the southern part of York County, and in New Hampshire to Rockingham County. It is common in south-eastern Massachusetts and in Rhode Island, and is occasionally seen in Connecticut on wet peat mosses.[1] Harper[2] describes the cedar swamp along Baldwin Creek on Long Island, where there are thousands of trees 30 to 40 ft. high and 3 to 10 in. in diameter. He says it is one of the very few trees in the north that are indigenous both in the glaciated region, and on the coastal plain. In the south, Harper states that it has a very erratic and local distribution, being entirely absent from Georgia, and confined strictly to near the sea-coast. He found it abundant for a few miles in Moore County, North Carolina, between Aberdeen and Keyser, where it grew in non-alluvial swamps between the sand-hills. It also grows in some parts of New Jersey and Maryland, and in the great Dismal Swamp of Virginia. Mayr[3] found the average size of trees growing on white sandy soil in Alabama to be 86 ft. in height and 2 ft. in diameter; in New York it attains 19 in. in diameter at 128 years old. Plate 311 is from a photograph taken in North Carolina, for which we are indebted to the U.S. Forestry Bureau. (A. H.)

## CULTIVATION

The white cedar was introduced[4] into England by Peter Collinson in 1736; but it has never flourished except in rare cases, and its cultivation has been entirely neglected for the last fifty or sixty years.

Though Loudon states that in his time there was a magnificent specimen at Pains Hill 50 ft. high and 2 ft. in diameter, and another in the Duke of Devonshire's grounds at Chiswick, we can now find no trace of these.

The only good specimens which we have seen in cultivation are:—At Woburn Abbey, where by a walk leading to the estate office, I found in 1908 the finest tree of the species known in England, growing in rather damp soil, and measuring 46 ft. by 4½ ft. The next best are two at Arley Castle, which measured 44 ft. by 2 ft. 7 in., and 35 ft. by 2 ft. 9 in., in 1907. Another grows in rather heavy land at Strathfieldsaye, and measured in 1907, when it was bearing fruit, 38 ft. by 3 ft. 10 in.

A specimen at Pencarrow was 27 ft. by 3 ft. in 1909. There are others at Bayfordbury and High Canons in Herts, and at Kew. The glaucous form is flourishing at Little and Ballantyne's nursery, Carlisle, where it is reported that this species is perfectly hardy. It ripened seed as far north as Biel in 1825.[5]

We are informed by Mr. F. R. Twemlow that at Peatswood, Market Drayton, there are three trees of which the best is 31½ ft. high and 4 ft. 4 in. in girth near the ground, where it divides into several stems.

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[1] Dame and Brooks, *Trees of New England*, 25 (1902).

[2] In *Torreya*, iii. 122 (1903), vii. 199 (1907), and in *Rhodora*, vii. 71 (1905).

[3] *Waldungen Nord-Amer.* 193 (1890).

[4] Aiton, *Hort. Kew.* iii. 372 (1789). The following note, written by Peter Collinson, probably refers to this tree:—"Juniper, a new species, raised from Peter Kalm's seeds that he gave me, which he collected in a journey from Philadelphia to Quebec, and so to the Falls of Niagara and back to Pennsylvania. It has fine silver leaves." Cf. Dillwyn, *Hortus Collinsonianus*, 16 (1843).

[5] *Caled. Hort. Soc.* iii. 412 (1825).

It is probable that if it was planted on the southern coast in suitable places it would be longer-lived, and might be worth trying on account of its ornamental appearance and interest. As Loudon, however, points out, a swamp would probably be too cold in summer in this country; and a deep moist sand is probably the best soil for it.[1]

### TIMBER

In America the wood of this tree is highly valued for shingles, which were formerly used in New York, Philadelphia, Baltimore, and other towns in the district where it grows, in preference to those made of the wood of the deciduous cypress, because they do not split when nailed on the rafters. They were said to be more durable than white pine shingles, and to last for thirty to thirty-five years. It was also largely used by coopers for casks; and the poles are still highly valued for telegraph and fencing posts.

Defebaugh[2] quotes from Hough's *Report on Forestry* (1877), and from Cook's *Geology of New Jersey* (1868), very interesting details on the submerged cedar forests, which are found near Dennisville and elsewhere in New Jersey, and which are supposed by geologists to have been caused either by a subsidence of the land or an irruption of the sea. The trees here were larger than any found living in the adjacent country within the memory of man, some having been dug up which were 6 ft. in diameter, while trees 4 ft. through were common.

"The timber which is buried in the swamps undergoes scarcely any change, and trees which have been buried hundreds of years are as sound as ever. It would seem that most of the timber which ever grew in these swamps is still preserved in them. Trunks of trees are found buried at all depths, quite down to the gravel, and so thick that in many places a number of trials will have to be made before a sounding-rod can be thrust down without striking against them. Tree after tree, from 200 to 1000 years old, may be found lying crossed one under the other, some partly decayed, as if they had died and remained standing a long time and then been broken down. Others had been blown down, and some had continued to grow for a long time after falling, as known by the heart being much above the centre, and by the wood on the under side being hard and boxy. The trees lie in all directions, as if fallen at different times, and their united ages, as shown where trees have grown where others have fallen, amounts to some thousands of years. The process of mining this timber is as follows:—With an iron rod the swamp is sounded till it hits what is thought to be a good log. Its length and size is determined by the rod, as near as may be. A hole is dug with a sharp spade down to the log and a chip obtained, which, by its smell, shows whether it was a windfall or a breakdown. If the former, it was probably sound when it fell, and has since remained so. If thought worth working, the matted roots are cut away, the log is sawed off, and when loosened it at once floats in the water, which is always near the level of the swamp. Logs are sometimes worked, though rarely, to a length of 30 ft.. These logs come up with as much buoyancy as newly-fallen cedar, not being in the least water-logged, and the bark on the under side is quite fresh. The under side is always lightest, and turns up in rising to the surface. The workmen go over the same ground again and again, and find new logs each time, the lower logs probably rising in the mud when the roots over them are cut loose, and the logs which had laid on them are removed. These logs are found not only in the swamp, but also out in the salt-marsh beyond the living timber, and are worked below present tide-level." (H. J. E.)

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[1] Since writing the above, I have seen *C. thyoides* flourishing in the remarkable plantation near Bordeaux, made eighty to ninety years ago at Catros, by a nurseryman of that name. M. Jaille, the present proprietor, showed me, among other rare American trees, a specimen of this measuring 52 ft. by 4½ ft., and others perhaps taller with trunks clean to 8 or 10 ft. high. Several self-sown seedlings were growing in this place on a sandy moist soil, similar to that of the Landes.

[2] *History of the Lumber Industry of America*, ii. 494 (Chicago, 1907).

# QUERCUS

*Quercus*, Linnæus, *Gen. Pl.* 291 (1737), *Sp. Pl.* 994 (1753); Bentham et Hooker, *Gen. Pl.* 407 (1880).

*Lithocarpus*, Blume, *Bijdr. Fl. Ned. Ind.* 526 (1825).

*Synædrys*, Lindley, *Introd. Nat. System*, 441 (1836).

*Cyclobalanopsis*, *Cyclobalanus*, and *Pasania*, Oersted, in *Vidensk. Medd. Kjöbenh.*, 1866, pp. 77-81.

TREES or shrubs, belonging to the order Fagaceæ. Buds usually clustered at the ends of the branchlets, covered with numerous scales, imbricated in five ranks, and marking when they fall the bases of the branchlets with ring-like scars. Leaves either deciduous in autumn or in the following spring, or persistent two to four years; simple, alternate, five-ranked, stalked; lobed, toothed, or entire.

Flowers unisexual or rarely perfect, monœcious, apetalous, in spikes or catkins. Staminate flowers: calyx four- to seven-lobed; stamens four to six, rarely two, ten, or twelve, with slender filaments. Pistillate flowers, each enclosed in an involucre of imbricated scales; calyx six-lobed; ovary with two ovules in each of the three to five cells; styles three to five.

Fruit, a nut (the acorn), ripening in one or two years, with a large pale scar at the base, more or less surrounded by the woody cupule, resulting from the growth of the involucre of the flower. The acorn contains one seed, which is marked at the base, apex, or sides by the aborted ovules; cotyledons thick and fleshy, not raised above the ground on germination.

About 275 species of oak have been described, inhabiting the temperate regions of the northern hemisphere and high altitudes within the tropics, ranging in the New World southwards to Colombia, and in the Old World to the Malay Archipelago.

The genus may be divided into the following sections, one of which, *Pasania*, is now considered by many botanists to be a distinct genus.

* *Staminate flowers in pendulous, slender, clustered spikes. Styles flattened, with the stigmatic surface on the upper side.*

I. LEPIDOBALANUS, Endlicher.

Staminate flowers solitary. Pistillate flowers in few-flowered separate spikes. Cupule of the fruit saucer- or cup-shaped, with imbricated scales, free at their apices.

This section includes, with one exception (*Q. densiflora*), all the oaks of North America, Europe, northern Africa, and western Asia; and a large number of those in the Himalayas and eastern Asia. Many of these are in cultivation, and may be grouped into the following subsections:—

(a) *Erythrobalanus*, Spach.

Fruit ripening in two years; aborted ovules in the upper part of the acorn; cupule scales all appressed. Trees with bristle-pointed leaves, confined to North America, and comprising the oaks there known as willow, black, and red oaks. The introduced species are—*Q. Phellos*, *Q. cinerea*, *Q. imbricaria*, *Q. nigra*, *Q. marylandica*, *Q. cuneata*, *Q. ilicifolia*, *Q. velutina*, *Q. Kelloggii*, *Q. rubra*, *Q. coccinea*, *Q. palustris*, *Q. Schneckii*, with deciduous foliage; and *Q. agrifolia*,[1] *Q. Wislizeni*, and *Q. crassipes*, with evergreen foliage.

(b) *Cerris*, Spach.

Fruit ripening in two years; aborted ovules at the base of the acorn; cupule scales spreading, often reflexed.

Trees of Europe, northern Africa, and Asia. The species in cultivation are—*Q. Cerris*, *Q. Ægilops*, *Q. castaneæfolia*, *Q. Libani*, *Q. macedonica*, *Q. serrata*, *Q. variabilis*, and *Q. dentata*,[2] with deciduous foliage; *Q. alnifolia* and *Q. coccifera*, with evergreen foliage.

(c) *Leucobalanus*, Engelmann.

Fruit usually ripening in one year; aborted ovules at the base of the acorn; cupule scales appressed.

Trees of North America, Europe, northern Africa, and Asia. All the oaks which are known to produce timber of the first quality belong to this subsection, which may be divided into three groups:—

(*a*) Leaves evergreen. The species in cultivation are—*Q. Ilex* and *Q. Suber*[3] of the Mediterranean region, *Q. incana*[3] and *Q. semecarpifolia*[3] from the Himalayas, *Q. phillyræoides*[3] from Japan, and *Q. chrysolepis* and *Q. glabrescens* from North America.

($\beta$) Leaves deciduous. The white oaks of North America. The species in cultivation are—*Q. alba*, *Q. lyrata*, *Q. macrocarpa*, *Q. lobata*, *Q. bicolor*, *Q. Prinus*, *Q. Muehlenbergii*, *Q. prinoides*, and *Q. obtusata*.

($\gamma$) Leaves deciduous. Natives of the old world. The species in cultivation are—*Q. pedunculata*, *Q. sessiliflora*, *Q. lanuginosa*, *Q. Toza*, *Q. conferta*, *Q. Mirbeckii*, *Q. pontica*, *Q. macranthera*, *Q. lusitanica*, *Q. infectoria*, *Q. glandulifera*, *Q. grosseserrata*.

## II. Cyclobalanopsis.

Flowers as in Lepidobalanus. Cupule of the fruit cup-shaped, with scales united into concentric zones.

Evergreen trees, inhabiting the Himalayas, China, and Japan; leaves usually dentate. The introduced species are *Q. glauca*, *Q. Vibrayeana*, and *Q. acuta*.

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[1] This species ripens its fruit in one year.

[2] In this species the fruit ripens in one year.

[3] The leaves of *Q. semecarpifolia* are subevergreen. In *Q. Suber*, var. *occidentalis*, *Q. phillyræoides*, *Q. incana*, and *Q. semecarpifolia*, the fruit ripens in the second year.

* * *Staminate flowers in erect, simple or panicled spikes. Styles terete, erect, stigmatic at the apex only.*

III. Pasania.

Staminate flowers solitary or in cymes of two to five. Pistillate flowers, in separate spikes or at the base of the staminate spikes. Fruit ripening in two years; cupule various, (*a*) completely enclosing the acorn and dehiscent or indehiscent at maturity, (*b*) cup-shaped, with scales imbricated and free at their apices, or (*c*) cup-shaped, with scales coalesced into concentric zones.

This section comprises about 100 species, all evergreen trees, with entire or toothed leaves, mostly inhabiting eastern and south-eastern Asia and the Malay Archipelago, one species (*Q. densiflora*) occurring in California. The latter species and two from Japan, *Q. glabra* and *Q. cuspidata*, have been introduced into cultivation.

The following artificial key of the cultivated species of Quercus is based upon the characters of the branchlets, leaves, and buds.

I. *Leaves deciduous in autumn, or early in the following year, falling before the new leaves appear.*

A. *Leaves entire, with a bristle at the apex.*

1. *Quercus Phellos*, Linnæus. United States. See p. 1228.

Branchlets glabrous. Leaves oblong or lanceolate, glabrous beneath, 2½ to 5 in. long, about ½ in. wide; stalk ⅛ to ¼ in.

2. *Quercus cinerea*, Michaux. United States. See p. 1230.

Branchlets tomentose. Leaves lanceolate, white-tomentose beneath, 2 to 3 in. long, ½ to ¾ in. wide; stalk ⅛ to ¼ in.

3. *Quercus imbricaria*, Michaux. United States. See p. 1231.

Branchlets glabrescent. Leaves lanceolate, with a greyish green stellate-pubescent under surface, 4 to 6 in. long, 1 to 2 in. wide; stalk ½ in.

B. *Leaves lobed; lobes and their teeth tipped with long fine bristles.*

* *Leaves oblong, with short variable lobes.*

4. *Quercus heterophylla*, Michaux. A hybrid. See p. 1233.

Branchlets glabrous. Leaves glabrous, except for axil-tufts beneath, 3 to 6 in. long, 1 to 2 in. wide; stalk ½ to 1½ in.

5. *Quercus Leana*, Nuttall. A hybrid. See p. 1232.

Branchlets stellate-pubescent. Leaves with scattered stellate pubescence beneath, 5 to 7 in. long, 2 to 2½ in. wide; stalk ½ to 1 in.

6. *Quercus nigra*, Linnæus. United States. See p. 1235.

Branchlets glabrous. Leaves extremely variable, oblong with three to seven short lobes, obovate, or oval; glabrous beneath, except for axil-tufts; 3 to 4 in. long, 1 to 2 in. wide; stalk short, not exceeding ¼ in. long.

** *Leaves obovate,*[1] *with three to five lobes.*

7. *Quercus marylandica*, Muenchhausen. United States. See p. 1236.

Branchlets at first stellate-pubescent, later glabrous. Leaves with dense bands of stellate pubescence along the sides of the midrib and nerves, 5 to 7 in. long and wide; stalk not exceeding ½ in.

8. *Quercus ilicifolia*, Wangenheim. United States. See p. 1238.

Branchlets pubescent. Leaves densely white or grey tomentose beneath, 3 in. long, 2 in. wide; petiole ½ in. long.

9. *Quercus cuneata*, Wangenheim. United States. See p. 1237.

Branchlets pubescent. Leaves either (*a*) cuneate at the base and three-lobed above; or (*b*) oblong obovate, five- to seven-lobed, cuneate or rounded at the base; densely grey tomentose beneath; 5 to 7 in. long, 3 to 4 in. wide; petiole ¾ to 1 in. long.

10. *Quercus Catesbæi*; Michaux. United States. Not now in cultivation in England.

Branchlets glabrescent. Leaves (Plate 333, Fig. 1) divided into three to five long narrow lobes; lower surface glabrous, except for dense pubescence in the axils and on the main nerves; stalk ¼ to ¾ in. long.

*** *Leaves oval, with seven to nine large lobes, usually toothed.*

(a) *Leaves densely tomentose beneath.*

10A. *Quercus cuneata*, Wangenheim. See No. 9, the five- to seven-lobed form.

11. *Quercus pagodæfolia*, Ashe. United States. See p. 1237, note 2.

Not yet introduced. Leaves similar to the five- to seven-lobed form of *Q. cuneata*, but covered beneath with a silvery white tomentum; stalk 1½ to 2 in. long.

(b) *Leaves, with scattered stellate pubescence over the whole of the lower surface.*

12. *Quercus velutina*, Lamarck. United States. See p. 1239.

Branchlets with scattered stellate pubescence. Leaves shining dark green above; lower surface with rusty pubescent axil-tufts; 5 to 9 in. long, 4 to 5 in. wide; stalk 1 to 3 in. long.

13. *Quercus Kelloggii*, Newberry. California, Oregon. See p. 1241.

Branchlets glabrescent. Leaves without axil-tufts beneath, 3 to 6 in. long, 2 to 4 in. broad; stalk 1 in. long.

(c) *Leaves glabrous beneath, except for tufts of pubescence in the axils. Branchlets glabrous.*

14. *Quercus rubra*, Linnæus. North America. See p. 1242.

Leaves with axil-tufts inconspicuous or absent, dull green beneath, turning dull red or reddish brown in autumn, 5 to 8 in. long, 4 to 6 in. broad. Buds ¼ in. long, reddish, pubescent only at the tip.

15. *Quercus coccinea*, Muenchhausen. North America. See p. 1247.

Leaves with axil-tufts inconspicuous or absent, shining green on both surfaces, turning scarlet in autumn, 3 to 6 in. long, 2½ to 4 in. broad. Buds ⅛ to ¼ in. long, whitish pubescent in their upper half.

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[1] *Quercus nigra* (See No. 6), in the form with obovate leaves, would be found here.

16. *Quercus palustris*, Muenchhausen. United States. See p. 1250.

Leaves with conspicuous axil-tufts, turning scarlet in autumn, 4 to 6 in. long, 2 to 4 in. wide. Buds ⅛ in. long, pale brown, glabrous.

17. *Quercus Schneckii*, Britton. United States. See p. 1251.

Not distinguishable with certainty in the absence of fruit from *Q. palustris*.

**** *Leaves ovate, with ten or more sharp triangular teeth or lobes.*

18. *Quercus Ægilops*, Linnæus. Greece, Asia Minor. See p. 1268.

Leaves tomentose beneath, margin and bristles ciliate, 3 to 4 in. long, 1½ to 2 in. broad. Branchlets tomentose. Buds with persistent stipules.

C. *Leaves serrate, each serration ending in a long projecting bristle or spine.*

19. *Quercus serrata*, Thunberg. Himalayas, China, Japan. See p. 1275.

Branchlets glabrescent. Leaves oblong-lanceolate, with ten to sixteen pairs of lateral nerves, each ending in a serration; green and glabrous beneath, except for slight axil-tufts; 4 to 8 in. long, 1 to 2 in. wide.

20. *Quercus variabilis*, Blume. China, Japan. See p. 1276.

Similar to the last, but with leaves covered beneath with a dense white tomentum.

21. *Quercus Libani*, Olivier. Syria, Asia Minor, Armenia. See p. 1274.

Branchlets pubescent or glabrescent. Leaves lanceolate, with nine to twelve pairs of lateral nerves, each ending in a serration; wrinkled in margin, glabrous beneath except on the midrib and nerves; 3 in. long, ¾ in. wide.

22. *Quercus semecarpifolia*, Smith. Himalayas. See p. 1297.

Branchlets stellate-pubescent. Leaves[1] subevergreen, elliptical, with six to ten pairs of lateral nerves, forking before reaching the spinose-serrate margin; 3 in. long, 2 in. broad.

D. *Leaves lobed or toothed, each tooth or lobe ending in a projecting short mucro.*

* *Axillary buds without persistent stipules.*

23. *Quercus macedonica*, De Candolle. Macedonia, Albania, Montenegro, Herzegovina, and south-eastern Italy. See p. 1273.

Branchlets with scattered pubescence. Leaves lanceolate, 2 in. long, subsessile, broad and auricled at the base, with nine to twelve pairs of nerves each ending in a serration; margin wrinkled.

24. *Quercus glandulifera*, Blume. China, Korea, Japan. See p. 1327.

Branchlets glabrescent. Leaves obovate, 3 to 5 in. long, with eight to eleven pairs of nerves, all but the lowest one or two pairs, ending in a mucronate serration; lower surface appressed pubescent, and usually glaucous.

25. *Quercus Turneri*, Willdenow. A hybrid. See p. 1288.

Branchlets stellate-pubescent. Leaves subevergreen, obovate, 3 to 5 in. long, with five to eight pairs of nerves, all but the lowest one or two pairs, ending in a sinuate mucronate tooth;[1] lower surface green, with scattered stellate pubescence.

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[1] The leaves on old trees are entire or slightly undulate and without spines.

26. *Quercus pontica*, Koch. Western Caucasus and Lazistan. See p. 1321.

Branchlets glabrous. Leaves elliptic, 6 in. long, 3 in. broad, with fifteen to twenty pairs of nerves, each ending in an incurved mucronate serration; lower surface glaucous, pilose on the midrib and nerves, elsewhere glabrous.

26A. *Quercus lusitanica*, Lamarck. See No. 50.

** *Axillary buds surrounded by long filiform stipules.*

27. *Quercus castaneæfolia*, Meyer. Algeria, Caucasus, north Persia. See p. 1271.

Branchlets pubescent. Leaves oblong, 3 to 6 in. long, 1½ to 2½ in. wide, with eight to fourteen pairs of nerves, each ending in a mucronate triangular tooth; lower surface pale green, covered with a minute tomentum.

28. *Quercus Lucombeana*, Sweet. A hybrid. See p. 1259.

Branchlets tomentose. Leaves subevergreen, variable in size and shape, 2 to 5 in. long, with rather irregular mucronate lobes or teeth, densely white or grey tomentose beneath.

E. *Leaves lobed or toothed, without projecting bristles or points.*

* *Branchlets glabrous or glabrescent.*

(a) *Leaves regularly toothed, or shortly lobed with shallow sinuses.*

† *Leaves obovate.*

29. *Quercus bicolor*, Willdenow. North America. See p. 1307.

Leaves white tomentose beneath and velvety to the touch, with six to eight pairs of rounded, rarely acute teeth; 5 to 6 in. long, 2 to 4 in. wide; petiole ½ in. long.

30. *Quercus prinoides*, Willdenow. United States. See p. 1311.

Leaves white or pale beneath with a minute scattered pubescence; with four to seven pairs of rounded, rarely acute teeth; 4 in. long, 2 in. wide; petiole ¼ to ½ in. long.

31. *Quercus Mirbeckii*, Durieu. Portugal, Algeria. See p. 1318.

Leaves glaucous and glabrous beneath, except for brown flocculent tomentum along the midrib; with nine to fourteen pairs of rounded or acute teeth; 4 to 6 in. long, 3 in. wide; petiole ½ to ¾ in. long.

32. *Quercus Prinus*, Linnæus. North America. See p. 1309.

Leaves pale beneath with a minute pubescence disappearing in summer; with nine to fourteen pairs of rounded teeth; 6 in. long, 3 in. wide; petiole ½ to 1 in. long.

33. *Quercus Michauxii*, Nuttall. North America. Not now in cultivation.

Leaves (see Plate 336, Fig. 34), lower surface green or whitish, covered with conspicuous stellate tomentum; with twelve to seventeen pairs of small triangular teeth; 6 in. long, 3 in. wide; petiole ½ to 1½ in. long.

34. *Quercus grosseserrata*, Blume. Japan. See p. 1327.

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[1] In var. *pseudoturneri* the mucro is often obsolete.

Leaves, lower surface pilose on the midrib and veins, elsewhere glabrous; with twelve to fifteen pairs of regular triangular teeth; 4 to 6 in. long, 3 to 3½ in. wide; subsessile, petiole not exceeding ⅛ in.

‡ *Leaves lanceolate.*

35. *Quercus Muehlenbergii*, Engelmann. North America. See p. 1310.

Leaves narrower than in *Q. Prinus*, 6 in. long, 2 in. wide, with eight to fifteen pairs of inflexed, rounded or acute teeth; with a minute pubescence beneath, often disappearing in summer; petiole ¾ to 1½ in. long.

(b) *Leaves irregularly toothed, or with conspicuous lobes and deep sinuses.*

† *Leaves quite glabrous beneath.*

36. *Quercus obtusata*, Humboldt and Bonpland. Mexico. See p. 1312.

Leaves subevergreen, falling in March, obovate, 4 to 5 in. long, narrowed and auricled at the base, margin with irregular callous-tipped teeth; petiole ¼ to ⅜ in.

37. *Quercus pedunculata*, Ehrhart. Europe. See Vol. II. p. 282.

Leaves deciduous in autumn, obovate, auricled at the base, with four to six pairs of mostly entire irregular lobes; 3 to 6 in. long; lateral nerves ending both in the lobes and in the sinuses; petiole usually less than ¼ in.

†† *Leaves pubescent beneath.*

38. *Quercus sessiliflora*, Salisbury. Europe. See Vol. II. p. 291.

Leaves obovate, cuneate at the base, with four to six pairs of mostly entire irregular lobes; nerves ending in the lobes; 3 to 5 in. long; lower surface green with scattered pubescence, densest on the midrib and nerves; petiole ½ to 1 in. long.

39. *Quercus alba*, Linnæus. North America. See p. 1301.

Leaves obovate, cuneate at the base, with seven to nine irregular, mostly entire lobes; upper lateral lobes smaller than those in the middle; lower surface pale or glaucous, uniformly covered with a very minute pubescence; 5 to 7 in. long; petiole ½ in. long.

40. *Quercus lyrata*, Linnæus. United States. See p. 1303.

Leaves obovate, cuneate at the base, with five to nine irregular triangular lobes, the upper two lateral lobes broad and emarginate and larger than the lower lobes; lower surface pale, with a minute pubescence throughout; 7 to 8 in. long; petiole ¼ to ¾ in.

** *Branchlets pubescent.*

(a) *Terminal and axillary buds surrounded by persistent stipules.*

41. *Quercus Cerris*, Linnæus. Southern Europe, Asia Minor. See p. 1254.

Leaves oblong or oval, about 5 in. long, with seven or eight pairs of entire or toothed lobes; lower surface green or greyish, covered with a minute stellate pubescence.

42. *Quercus macranthera*, Fischer and Meyer. Caucasus, north Persia. See p. 1322.

Leaves obovate, 4 to 5 in. long, with seven to eleven pairs of short, usually entire lobes; lower surface densely tomentose.

(b) *Only the terminal buds surrounded by persistent stipules.*

† *Leaves large, more than* 4 *in. long.*

43. *Quercus conferta*, Kitaibel. South-eastern Europe. See p. 1316.

Leaves obovate, 5 to 8 in. long, with six to eight pairs of regular, entire or sinuately toothed deep lobes, with sinuses extending half-way to the midrib; under surface green or greyish, covered with a thin minute stellate pubescence. Branchlets with scattered pubescence.

44. *Quercus Toza*, Bosc. France, Spain, and Portugal. See p. 1313.

Leaves obovate, 5 to 8 in. long, with five to six pairs of irregular, entire or sinuately toothed deep lobes; under surface greyish or whitish, covered with a dense soft tomentum. Branchlets densely tomentose.

45. *Quercus macrocarpa*, Michaux. N. America. See p. 1304.

Leaves obovate, 6 to 12 in. long, usually with five to seven lobes, the terminal lobe large and crenately lobulate, lateral lobes small with deep sinuses; under surface pale with a deciduous minute appressed pubescence.

46. *Quercus dentata*, Thunberg. China, Manchuria, Korea, Japan. See p. 1277.

Leaves obovate, 6 to 12 in. long, with six to nine pairs of shallow regular rounded, usually entire lobes; lower surface pale with a scattered minute stellate pubescence.

47. *Quercus stellata*, Wangenheim. North America. Not now in cultivation. See Plate 336, Fig. 32.

Leaves oblong obovate, 4 to 5 in. long, five-lobed, with deep sinuses; upper surface with conspicuous stellate hairs; lower surface densely pubescent.

† *Leaves small, not exceeding* 4 *in. long.*

48. *Quercus lobata*, Née. California. See p. 1306.

Leaves obovate, 3 in. long, with seven to eleven irregular lobes, the lateral lobes broad at their apex; both surfaces stellate-pubescent.

49. *Quercus lanuginosa*, Thuillier. S. Europe. See Vol. II. p. 294.

Leaves obovate, 3 to 4 in. long, with four to eight pairs of rounded, usually entire lobes; wrinkled in margin; under surface tomentose.

50. *Quercus lusitanica*, Lamarck. Mediterranean region. See p. 1322.

A very variable species, with leaves 2 to 4 in. long, obovate or oblong; margin wrinkled with regular or irregular teeth, with or without a mucro; lower surface covered with a dense grey tomentum.

51. *Quercus infectoria*, Olivier. Cyprus, Asia Minor, Turkey. See p. 1325.

Mainly distinguished from *Q. lusitanica* by the glabrescent under surface of the leaf.

51A. *Quercus Turneri*. See No. 25.

II. *Leaves evergreen, persisting more than one year on the branchlets.*

A. *Leaves entire on margin, or occasionally undulate-crenate towards the apex.*

52. *Quercus glabra*, Thunberg. Japan. See p. 1332.

Leaves lanceolate or elliptical, 4 to 5 in. long, acute or cuspidate at the apex, tapering at the base and prolonged as a narrow wing on each side of the petiole; under surface glabrous. Branchlets glabrous.

53. *Quercus acuta*, Thunberg. Japan. See p. 1330.

Leaves similar to those of *Q. glabra*, but with a long acuminate apex. Young branchlets covered at first with a brown tomentum, which quickly disappears, some, however, remaining near the tip of the branchlets or above the insertion of the leaves.

54. *Quercus cuspidata*, Thunberg. China, Japan, Formosa. See p. 1332.

Leaves elliptical, 2 to 3 in. long, with a long acuminate apex; lower surface glabrous. Branchlets slender, scaly.

55. *Quercus crassipes*, Humboldt and Bonpland. Mexico. See p. 1254.

Leaves oblong, 2 to 3 in. long, with a bristle point at the apex, brown tomentose beneath. Branchlets pubescent.

55A. *Quercus Ilex.* See No. 56.

B. *Leaves distinctly toothed in margin, and plainly pubescent on the lower surface.*

* *Leaves white or grey beneath.*

(a) *Leaves not lanceolate.*

56. *Quercus Ilex*, Linnæus. Mediterranean region. See p. 1281.

Leaves very variable, ovate or oval, 1 to 3 in. long; margin entire or spinose-dentate; lower surface covered with a dense greyish or whitish tomentum; lateral nerves, seven to ten pairs; stipules long, linear, persistent around the terminal bud.

57. *Quercus Suber*, Linnæus. Mediterranean region. See p. 1292.

Leaves ovate or oblong, about 2 in. long, usually concave; margin with small mucronate teeth; lower surface covered with a dense greyish tomentum; lateral nerves, five to seven pairs; stipules short, linear-obovate, occasionally persistent, but inconspicuous around the terminal bud.

58. *Quercus alnifolia*, Poech. Cyprus. See p. 1278.

Leaves orbicular or obovate, 1½ to 2 in. long, usually concave; margin with minute mucronate teeth; lower surface covered with a dense yellowish grey tomentum; lateral nerves, five to eight pairs, very prominent.

(b) *Leaves lanceolate*

59. *Quercus incana*, Roxburgh. Himalayas. See p. 1298.

Leaves elliptic-lanceolate, acuminate at the apex, 3 to 6 in. long; nerves, ten to fifteen pairs, each ending in a mucronate triangular serration; lower surface densely white tomentose.

60. *Quercus glauca*, Thunberg. Himalayas, China, Japan. See p. 1328.

Leaves ovate-lanceolate, acuminate, about 3 in. long; nerves, about ten pairs; mucronate-serrate in the upper half; lower surface white, with scattered appressed silky hairs.

** *Leaves green beneath.*

61. *Quercus glabrescens*, Bentham. Mexico. See p. 1300.

Leaves obovate-oblong, 2 to 2½ in. long, with a few gland-tipped teeth in the upper half; lateral nerves, seven or eight pairs; lower surface yellowish green with a scattered stellate pubescence.

62. *Quercus chrysolepis*, Liebmann. Oregon, California, Lower California. See p. 1299.

Leaves very variable; on young trees, oblong-ovate, 2 in. long, with eleven to twenty-one spine-tipped, small, triangular teeth; lower surface pubescent with scattered yellow appressed hairs and dotted with minute shining glands.

C. *Leaves distinctly toothed in margin, glabrous or nearly so on the lower surface.*

* *Leaves over* 3 *in. long.*

63. *Quercus Vibrayeana*, Franchet and Savatier. China, Japan. See p. 1329.

Leaves lanceolate, 3 to 4 in. long, acuminate; lateral nerves, nine to twelve pairs, inconspicuous; margin mucronate-serrate in the upper half; lower surface glaucescent. Branchlets glabrous.

64. *Quercus densiflora*, Hooker and Arnott. Oregon, California. See p. 1331.

Leaves oblong, 3 to 4 in. long, acute at the apex; lateral nerves, about twelve pairs, very prominent; margin serrate; lower surface whitish, glabrous or with rusty pubescence on the midrib at the base. Branchlets stellate-tomentose.

** *Leaves less than* 3 *in. long.*

65. *Quercus agrifolia*, Née. California. See p. 1252.

Leaves ovate or orbicular, 1½ to 2 in. long, with seven to thirteen spine-tipped teeth; lateral nerves, four to five pairs, prominent; lower surface glabrous, except for conspicuous reddish axil-tufts.

66. *Quercus phillyræoides*, A. Gray. China, Japan. See p. 1298.

Leaves oval or obovate, 1½ to 2 in. long, with seven to twenty serrations in the upper half or two-thirds; lateral nerves, about eight pairs, very slender, scarcely raised; lower surface glabrous, except for dense pubescence on the midrib at the base, continuous with that on the petiole.

67. *Quercus coccifera*, Linnæus. Mediterranean region. See p. 1279.

Leaves oval or oblong, 1 to 1½ in. long; margin wrinkled, with nine to seventeen spine-tipped teeth; lateral nerves, five to ten pairs, inconspicuous. Buds ovoid, obtuse, $\frac{1}{10}$ in. long.

68. *Quercus Wislizeni*, A. de Candolle. California, Lower California. See p. 1253.

Leaves similar to those of *Q. coccifera*, but darker green in colour. Buds conical, pointed, ⅛ in. or more in length. (A. H.)

## CULTIVATION OF THE AMERICAN OAKS

Though many of the American Oaks have been for at least a century in this country, and have been repeatedly introduced at various times, yet very few have established themselves in popular favour as ornamental trees; and none can be said to have any economic value, which would justify their being planted as forest trees. The most valuable in America, the white oak, seems unable to live for more than a few years in any part of this country; and none of the group to which it belongs, so far as we know, have ever attained a size which would justify our advising them for general cultivation.

*Q. virginiana*, Miller, the live oak of North America, which is widely spread in the southern United States and in Mexico, differs only slightly in botanical characters from *Q. Ilex*; but is not hardy in England, although Loudon,[1] who refers to it as *Q. virens*, Aiton, states that there was a tree of it at Kew, 40 to 50 ft. high, in 1838. This tree was no doubt *Q. Ilex*. There is no specimen now at Kew; and Mr. Bean[2] reports that living plants imported in recent years have died even in mild winters. Bunbury[3] says that one planted at Barton, Suffolk, was speedily killed.

Though several of the Californian oaks[4] have been introduced, and a few are living at Kew, Tortworth, and elsewhere, they do not grow with the same vigour which many of the conifers of the west coast of America have shown, and probably require a much warmer and drier summer climate. *Q. Garryana*, Hooker, *Fl. Bor. Am.* ii. 159 (1839), is a large and picturesque tree, found along the Pacific slope, from British Columbia, Vancouver Island, and Washington, where it is the only species known, through Oregon to the Santa Cruz mountains in California. So far as we know, it has never been tried in England, which is remarkable, considering how easy it would be to procure acorns. It might possibly succeed well in our climate. According to Schneider, *Laubholzkunde*, i. 206 (1904), who mentions a plant in the Darmstadt Botanic Garden, it was recently introduced into Germany by C. A. Purpus.

Of the group, known as the red and black oaks, several have been fairly successful; and though, with the exception of *Q. rubra*, not often planted at the present time, they are well worth more attention than they receive, on account of the beautiful colour of their leaves in autumn.

Most of the American oaks which were grown by Loddiges and other English nurserymen seventy to eighty years ago, were propagated by grafting on the common oak close to the ground; but now that acorns can be procured so much more quickly through the post, it would seem better to raise them from seed. Although the practice of grafting is not to be recommended for many genera of trees, yet we have seen many instances of oaks grafted close to the ground on suitable stocks, which have produced fine and sometimes very large trees. The main points seem to be that the stock shall be a vigorous one, with good fibrous roots which have not been stunted in pots; and that the species selected for the stock should be suited to the scion, and to the soil. *Quercus pedunculata* is a good stock, on strong land, for species allied to it, *Q. sessiliflora* for lighter soil; *Q. Cerris* for the species with mossy cups; *Q. Ilex* for the evergreen oaks of the Mediterranean region; *Q. rubra* for the American red or black oaks. I have noticed that a better union of stock and scion seems to be produced by saddle- or cleft-grafting, than when the scion is inserted on one side of the stock.

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[1] *Arb. et Frut. Brit.* iii. 1918 (1838).

[2] *The Garden*, lxv. 386 (1904).

[3] *Arboretum Notes*, 113 (1889).

[4] *Q. Gambelli*, Nuttall, a small tree, rarely exceeding 25 ft. in height, is widely spread at high elevations in Colorado, Utah, Nevada, Arizona, Texas, and New Mexico. It does not appear to have been introduced into Europe (cf. Schneider, *Laubholzkunde*, i. 204). The leaves are figured in Plate 333, Fig. 7.

I collected acorns of a good many species about the end of September 1904, in the Arnold Arboretum and other places in North America; and found that by packing them in small tin boxes in slightly damp moss, they arrived here in good condition, though those of the white oak germinated on the voyage. Nearly all of those which I sowed in a cold frame germinated and grew well during the following summer; but when planted out, many of them became sickly and died, apparently from insufficient summer heat to ripen their wood.

Loudon says that at the Leyton Nursery, near Stratford, there were in the autumn of 1836 a great variety of American oaks, selected from the seed beds when two years old and planted in rows. The variety and beauty of these exceeded anything he ever saw, in spring when coming into leaf, in summer when in full foliage, and in autumn when the leaves were dying off of every shade of scarlet, yellow, and purple. They were mostly ten to twelve years from the acorn, and with few exceptions were 20 to 30 ft. high. Many of these were burnt for want of purchasers, but, no doubt some of them survive in old places round London, where there may be some uncommon trees that we have not been able to discover.

Though none of the English nurseries, as far as we know, now pay much attention to the American oaks, yet they may be procured from American nurseries at one or two years old, in autumn, when they travel safely, if well packed; but if older than this the roots are too large to transplant well. The Earl of Ducie has probably planted more species and paid more attention to them than any one in England, and at Tortworth there are young trees of 20 to 30 ft. high of *Q. imbricaria*, *nigra*, *Kelloggii*, and others, which are growing fairly well in a sheltered hollow. The majority seem to prefer a deep fertile soil, rather light than heavy, with little or no lime in it; and though we have little experience as to their tolerance of shade in this country, yet if they were planted in small clearings, in the shelter of a warm sunny wood, they would probably succeed better than when exposed to cold winds in a north or east aspect. The remarkable success of several American oaks at Lyndon near Oakham in an exposed situation, shows what may be done in places where the conditions are not specially favourable.

The ultimate success of exotic trees which ripen their young wood badly in youth, seems to be largely a question of the genial character of the first few summers after planting, for if badly checked in their youth, they recover vigour slowly or never. Care should be taken by judicious pruning when young, to train them into a good shape, for slow-growing oaks resent the pruning of large limbs.

The healthy condition of the oak collection at Kew, which is by far the most complete we know of, seems largely due to the care and skill which has been given to them by a succession of able arboriculturists.

### CULTIVATION OF THE MEDITERRANEAN OAKS

Though the species of oaks found in various parts of the Mediterranean region are very numerous, few of them are fit for cultivation in England, as long experience has proved. In the warmest parts of the south and east coast, especially near the sea and on good deep soil in sheltered positions, some of them will attain very large dimensions, as our account of the cork tree and *Q. Ilex* proves; but the severe winters which occur at long intervals even in these favoured places, and the want of hot dry autumnal weather necessary to ripen their late growth, too often cripple them when young, and destroy them when old. At the same time, there are several which may, with care in planting and sheltering them during their early years, be well worth more extended trials than they have had; and now that modern means of communication has brought regions which were formerly remote within easy reach by post, I would advise those planters who like variety, to try such species as *Ægilops*, *Libani*, *alnifolia*, *pontica*, *lusitanica*, *macedonica*, and *Toza*, as well as those which we know to be capable of becoming fine trees like *Mirbeckii*, *conferta*, *castaneæfolia*, and perhaps *macranthera*.

### CULTIVATION OF THE ASIATIC OAKS

Though several of the Chinese, Japanese, and Himalayan oaks have proved hardy in the warmer parts of England, and are more or less ornamental on account of their evergreen foliage; yet none, so far as we can judge at present, seem at all likely to attain timber size in this country, or to be worthy of cultivation except in botanic gardens. It is perhaps premature to condemn them until they have been tried for a longer period, but it is evident that they require climatic conditions which are rarely found. The same may be said of the Mexican oaks, many of which grow at high elevations and were introduced long ago, but of which only two or three species seem to have survived.

Acorns should be procured as fresh as possible, and sown at once in deep pots or boxes, which can be kept under glass for two or three years before planting out. If acorns of suitable species are established in the places where the trees are to be planted, to serve as stocks for grafting on, when the scions are large enough, a double chance of success will be had. But in these days too little care and attention is paid to the necessary pruning and training, which almost all kinds of hardwoods require to make them really ornamental trees, and unless this is attended to every two or three years for a considerable time, as at Kew, the side branches often become so strong that the main trunk is weakened, and the shape of the whole tree spoilt. The sooner this is done in reason the better, and as the individuals of most species seem to vary very much in their constitution and vigour, it is never wise to depend on one plant of a species to get a good tree. If three or more are planted in the space which one will eventually fill, we get to some extent the same power of selection which always operates on seedlings in nature, in the struggle for existence.

As regards soil I have observed that most oaks grow better on red sandstone than on any other soil, and though some of the oriental and Mediterranean oaks naturally grow on limestone, they do not seem to need lime here.

From an economic point of view, I say without hesitation that there is no exotic species capable of competing either on heavy or light soil with our native oaks, and though the timber of the Ilex, the Lucombe, or the cork oak may be very valuable for decorative purposes when large enough, it can rarely be grown to a profit in this country.

In *Journ. Hort. Soc.* ix. 207 (1855) there is a long list of plants describing the effect of the winter of 1853-54, which was more destructive than any since 1838, the temperature registered at Chiswick having been 8° on 28th December, and 4° on 2nd January; near Nottingham, −4°; at Chatsworth, −6°; at Bicton, 15°; and at Dropmore on 3rd January, 4°. In the list of oaks we give the names as printed:—*Quercus*, Mexican, all killed, Chiswick. *Quercus sclerophylla*,[1] killed, Acton Green; injured, Bagshot; killed, Bicton. *Quercus Ilex*, much injured in 1838, Kew; not injured, Chiswick; large tree very much injured, Shifnal; some plants fifty years old dead, Nottingham. *Quercus Gramuntia*,[2] killed, Rolleston, Oulton; untouched, Chiswick. *Quercus Suber*, injured, Bromley; much injured, Nottingham. *Quercus Brantii*,[3] and other Kurdistan oaks, not injured by the winter, but very much injured by the frost on 24th April, Chiswick; injured, Oulton; quite safe, Congleton. *Quercus dealbata*,[4] uninjured, Bicton. *Quercus australis*,[5] not injured, Chiswick. *Quercus Cookii*,[6] leaves injured only, Chiswick. *Quercus glabra*, not affected, Bagshot; not hurt, Exeter or Bicton. *Quercus mongolica*,[7] uninjured, Shifnal.

(H. J. E.)

## QUERCUS PHELLOS, Willow Oak

*Quercus Phellos*, Linnæus, *Sp. Pl.* 994 (excluding vars.) (1753); Loudon, *Arb. et Frut. Brit.* iii. 1894 (1838); Sargent, *Silva N. Amer.* viii. 179, t. 435 (1895), and *Trees N. Amer.* 247 (1905).

A tree, attaining in America 80 ft. in height and 12 ft. in girth. Bark about ½ in. thick, smooth, except on old trunks, which are roughened by longitudinal narrow slightly raised scaly ridges. Young branchlets slender, reddish brown, glabrous or glabrescent. Leaves (Plate 339, Fig. 75) deciduous, thin, membranous, lanceolate, 2½ to 5 in. long, about ½ in. wide, gradually narrowing at both ends, glabrous except for slight pubescence along the midrib beneath, entire or slightly undulate in margin, with a single bristle point at the apex; venation pinnate, the primary veins dividing and looping with those adjoining before reaching the margin; petiole ⅛ to ¼ in. long, pubescent. The leaves are revolute in the bud; and on young specimens are dentate or lobed.

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[1] A Chinese species, introduced by Fortune in 1846, not now in cultivation, so far as we know.

[2] A variety of *Q. Ilex*. Cf. p. 1282.

[3] *Q. Brantii*, Lindley, in *Bot. Reg.* xxvi., *app.* 74 (1840), and *Gard. Chron.*, 1853, p. 263, was introduced from Kurdistan by Sir A. H. Layard about the year 1853; but, so far as we know, is not now in cultivation. The Earl of Ducie informed me that Lord Somers raised a tree at Eastnor Castle from Sir A. H. Layard's acorns, which had borne fruit before it was blown down.

[4] *Q. dealbata*, Wallich, *List* 2769, is now identified with *Q. incana*, Roxburgh. Cf. p. 1298.

[5] A form of *Q. lusitanica*. Cf. p. 1322.

[6] Identified with *Q. Ilex*, var. *Gramuntia*. Cf. p. 1282.

[7] Probably incorrectly named. Cf. p. 1328, note 1.

Fruit ripening in the second year, sessile or with short stalks, usually solitary; acorn subglobose or hemispherical, pale pubescent, enclosed at the base by a thin saucer-shaped cupule, ½ in. wide, silky pubescent on the inner surface, and covered externally by thin ovate truncate hoary pubescent scales.

This oak is supposed to form hybrids with several species, as *Q. imbricaria*,[1] *Q. marylandica*,[2] *Q. ilicifolia*,[3] *Q. cuneata*,[4] and *Q. palustris*,[5] none of which are in cultivation in this country. Under the name *Q. heterophylla* (see p. 1233) a tree is occasionally cultivated, which probably includes hybrids of *Q. Phellos*, with *Q. rubra* and *Q. velutina*.

The willow oak inhabits the banks of marshes and streams, and grows also in deep sandy tracts in the uplands; and, according to Sargent, is distributed from Staten Island, New York, through the Atlantic states, where it is usually confined to the maritime plain, as far southward as north-eastern Florida, extending westward through the Gulf states to the Sabine river, Texas, and ascending the lower Mississippi basin, through Arkansas and south-eastern Missouri to central Tennessee and southern Kentucky.

According to Catesby, this tree was introduced about 1723, when it was growing in the garden of Mr. Fairchild at Hoxton. It appears, from the singularity of its leaves, to have early attracted considerable notice; and Loudon mentions several trees of large size, some of which still survive. (A. H.)

It seems to succeed better in England than most of the American oaks, except *Q. rubra* and *Q. palustris*; and, though a lover of moisture in its own country, grows well in dry situations, as on gravel soil at Kew. So far as we know, however, none of the trees in cultivation have produced acorns.

The largest we have seen is at Whitton, which was mentioned by Loudon as being 70 ft. high by 7½ ft. in girth in 1838. It is now very large, about 100 ft. high by 12 ft. 4 in., but its trunk is attacked by fungus, and though the branches produced healthy foliage in 1905 it is evidently decaying rapidly. At Kew there are two fine healthy trees, one near the Pagoda which is divided into two main stems, and measured 85 ft. by 7 ft. 9 in. in 1909; the other near the pond is a much more spreading and thicker tree, and now measures about 55 ft. by 11 ft. At Arley Castle there is a healthy tree free from branches to about 30 ft. up and measuring 70 ft. by 5 ft. 9 in. At Cobham Park there is a fine tree of the same type 86 ft. by 8 ft. 10 in. At Croome Court, Worcestershire, there is a tree grafted on the common oak, 65 ft. by 6 ft. 5 in. At Nuneham Park, Oxon, another was in 1906, 60 ft. by 8 ft. 3 in. At Barton, Bury St. Edmunds, a slender tree measured in 1908, 64 ft. by 4 ft. 2 in.; at Ampton Park, Suffolk, another, measured by Henry in 1909, is 40 ft. by 5 ft. 10 in. At Glendurgan, Cornwall, Mr. A. B. Jackson measured a thriving tree, 40 ft. by 4 ft. 2 in. in 1908. In the Knaphill Nursery, near Woking, there are two specimens of moderate size. I have also seen specimens at Milford House, near Godalming, and at West Dean Park.

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[1] *Q. imbricaria* × *Phellos*, Zabel, *Laubholz-Benennung*, 65 (1903); *Q. Phellos*, var. *subimbricaria*, De Candolle, *Prod.* xvi. 2, p. 63 (1864). Found by Asa Gray in New Jersey. Leaves entire, broader and more obtuse than those of *Q. Phellos*, differing from *Q. imbricaria* in the deciduous pubescence on the under surface. This is included by Sargent under the next hybrid.

[2] *Q. Phellos* × *marylandica*, Sargent, *Silva N. Amer.* viii. 181, t. 437 (1895); *Q. Rudkini*, Britton, in *Bull. Torrey Bot. Club*, ix. 13 (1882). Trees, discovered in 1881 near Cliffwood in New Jersey, and subsequently seen in other parts of New Jersey and on Staten Island. Leaves trilobed at the apex; acorns intermediate between *Q. Phellos* and *Q. marylandica*. Dr. MacDougal (*Bot. Gaz.* xliii. 53, fig. 4 (1907)) raised seedlings, all of which bore foliage like that of the parent tree.

[3] *Q. Phellos* × *ilicifolia*, Peters, in *Bull. Torrey Bot. Club*, xx. 295 (1893). A tree found at May's Landing, New Jersey.

[4] Cf. Small, in *Bull. Torrey Bot. Club*, xxii. 74, fig. 232 (1895).

[5] *Q. Phellos* × *palustris*, Schneider, *Laubholzkunde*, 165 (1904): *Q. schochiana*, Zabel, *loc. cit.*, and *Mitt. deut. dend. Ges.*, 1896, p. 9.

In Scotland we know of no tree of this species; but in Ireland, at Fota, there is a thriving specimen, 45 ft. by 5 ft. 4 in. in 1907. (H. J. E.)

## QUERCUS CINEREA, BLUE JACK

*Quercus cinerea*, Michaux, *Hist. Chênes Am.* No. 8, t. 14 (1801); Sargent, in *Bot. Gaz.* xliv. 226 (1907).
*Quercus Phellos*, var. *brevifolia*, Lamarck, *Dict.* i. 722 (1783).
*Quercus humilis*, Walter, *Fl. Car.* 234 (1788) (not Lamarck).
*Quercus Phellos*, var. *sericea*, Aiton, *Hort. Kew.* iii. 354 (1789); Loudon, *Arb. et Frut. Brit.* iii. 1895 (1838).
*Quercus Phellos*, var. *humilis*, Pursh, *Fl. Am. Sept.* ii. 625 (1814).
*Quercus brevifolia*, Sargent, *Silva N. Amer.* viii. 171, t. 431 (1895), and *Trees N. Amer.* 250 (1905).

A tree, attaining in America 50 ft. in height and 5 ft in girth, but usually smaller. Bark about an inch thick, dark brown or nearly black, divided into small square scaly plates. Young branchlets slender, coated with white stellate tomentum, most of which disappears in the course of the summer. Buds minute, ovoid, obtuse, chestnut brown, glabrous. Leaves (Plate 339, Fig. 72) deciduous, membranous, 2 to 3 in., occasionally 5 in. long, ½ to ¾ in. broad, oblong-lanceolate, rounded or cuneate at the base, acute or rounded and with a bristle at the apex, entire and undulate in margin; upper surface dark green, shining, glabrescent; lower surface coated with thick greyish-white tomentum, disappearing in part in summer; petiole about ¼ in. long, tomentose.

Fruit ripening in the second year, sessile or shortly stalked; acorn ovoid, about ½ in. long, hoary pubescent at the apex; cupule variable in shape, saucer or cup-like, pale pubescent within, and covered externally by thin imbricated ovate tomentose scales.

This species,[1] which appears to be a variety of *Q. Phellos*, adapted by its tomentose leaves and branchlets to drier ground than that species, grows on sandy barren soil and on upland ridges, from North Carolina southward to Cape Malabar and Peace Creek, Florida, and westward to the Brazos river, Texas, usually not penetrating inland more than forty or fifty miles from the coast, though in Texas it has been found as far as Dallas, about lat. 33°.

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[1] *Q. pumila*, Walter, which resembles this species, is shrubby in habit, ripens its acorns in one year, and is practically evergreen, carrying its leaves until the new ones appear in the following spring. Cf. Sargent, *Silva N. Amer.* viii. 115, t. 404 (1895).

*Q. cinerea* is extremely rare in cultivation, the only specimen which we have seen being a healthy tree, about 30 ft. high, growing on the mound in the oak collection in Kew Gardens. (A. H.)

## QUERCUS IMBRICARIA, Shingle Oak

*Quercus imbricaria*, Michaux, *Hist. Chênes Am.* No. 9, tt. 15, 16 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1898 (1838); Sargent, *Silva N. Amer.* viii. 175, t. 432 (1895), and *Trees N. Amer.* 251 (1905).

*Quercus Phellos*, Linnæus, var. *imbricaria*, Spach, *Hist. Veg.* xi. 160 (1842).

A tree, attaining in favourable localities in America 100 ft. in height and 12 ft. in girth, but usually considerably smaller. Bark on young trees thin, smooth, and shining; on old trunks fissuring into broad, flat, scaly ridges. Young branchlets slender, quickly becoming glabrous. Leaves (Plate 339, Fig. 73) deciduous, oblong-lanceolate, 4 to 6 in. long, 1 to 2 in. broad, entire,[1] with slightly undulate margin, rounded or acute at the bristle-pointed apex, cuneate at the base; upper surface dark green, shining; lower surface greyish green, covered with a stellate tomentum; nerves pinnate, dividing and looping before reaching the margin; petiole pubescent, about ½ in. long.

Fruit usually solitary, on stout short stalks, ripening in the second year; acorn nearly globose, obscurely striate, enclosed for one-third its length in a thin shallow turbinate cupule, brown and shining internally, and covered with thin ovate pubescent reddish brown, closely imbricated scales.

This oak is supposed to form hybrids with *Q. marylandica*,[2] *Q. rubra*,[3] *Q. palustris*,[4] and *Q. velutina*. The hybrid with the last species, the only one known in cultivation in this country, is dealt with under the name *Q. Leana* (see p. 1232). (A. H.)

This species is a native of fertile soil, growing both on high land and in alluvial flats, and ranges from Pennsylvania westwards through southern Michigan and Wisconsin to northern Missouri and north-eastern Kansas, extending southwards along the Alleghany mountains to northern Georgia, Alabama, middle Tennessee, and northern Arkansas. It is comparatively rare in the east, being most abundant in the basin of the lower Ohio and in the State of Missouri, and attains its largest size in southern Indiana and Illinois. Ridgway says that with the possible exception of *Q. alba* it is the most abundant and generally distributed species in Wabash Co., Ill., where it is the most slender of all the oaks; trees 100 ft. high and 50 ft. to the first branch being only 6 to 7 ft. in girth. On poorer soil, however, where it is more abundant, it does not usually much exceed half this size. According to Sargent, it is occasionally planted in the northern states, being hardy as far north as Massachusetts.[1]

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[1] The leaves on very vigorous branchlets are sometimes three-lobed at the apex.

[2] *Q. imbricaria* × *marylandica*, Sargent, *Silva N. Amer.* viii. 176, t. 433 (1895); *Q. nigra*, var. *tridentata*, De Candolle, *Prod.* xvi. 2, p. 64 (1864); *Q. tridentata*, Engelmann, in *Trans. St. Louis Acad.* iii. 539 (1877). A single tree, now dead, found by Engelmann, near St. Louis.

[3] *Q. imbricaria* × *rubra*. Cf. Bush, in *Garden and Forest*, viii. 33 (1895).

[4] *Q. imbricaria* × *palustris*, Engelmann, in *Trans. St. Louis Acad.* iii. 539 (1877). A single tree found near St. Louis. Meehan raised five seedlings from its acorns, which agreed in every respect with the parent tree.

Although introduced into cultivation by John Fraser in 1786, it was a rare species in Loudon's[2] time, and no old trees exist, so far as we know, in this country. There are, however, two at Bayfordbury, supposed to have been planted with other American oaks in 1836, one of which measured 52 ft. high and 4 ft. 8 in. in girth in 1909; the other was 40 ft. by 4 ft. 9 in.

At Tortworth there is a healthy tree, about 35 ft. high. There is a well-grown tree in Mr. Young's nursery at Milford, near Godalming, which in 1909 was 60 ft. by 4½ ft., with a bole 20 ft. long. We have also identified trees of this species growing at Westonbirt, Kew, Beauport, Aldenham, and Yattendon Court near Newbury. (H. J. E.)

## QUERCUS LEANA

*Quercus Leana*, Nuttall, *Sylva*, i. 13, t. 5 *bis* (1842); Hill, in *Bot. Gaz.* xix. 171 (1894); Sargent, *Trees N. Amer.* 252 (1905).
*Quercus imbricaria* × *coccinea*, Engelmann, in *Trans. St. Louis Acad.* iii. 539 (1877).
*Quercus imbricaria* × *velutina*, Sargent, *Silva N. Amer.* viii. 176, t. 434 (1895).

A large tree. Young branchlets stout, reddish, with scattered stellate pubescence. Leaves (Plate 334, Fig. 10) oblong, lanceolate, 5 to 7 in. long, 2 to 2½ in. wide, with three to five pairs of short triangular bristle-pointed lobes, which in some cases are minute or absent; acute and mucronate at the apex, rounded or cuneate at the base; upper surface shining, dark green, with scattered, stellate, mostly deciduous pubescence; lower surface duller and paler, with persistent stellate pubescence, scattered between the veins, but densely crowded in tufts in the axils and in bands along the midrib; venation similar to that of *Q. heterophylla*; petiole, ½ to 1 in. long, with scattered stellate pubescence.

Fruit sub-sessile or on a short stalk, usually solitary; acorn sub-globose, enclosed to near the middle in a turbinate hemispherical cupule resembling that of *Q. velutina*, which is covered with ovate loosely imbricated pubescent scales.

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[1] *Q. laurifolia*, Michaux, a more southerly species, is closely allied to *Q. imbricaria*, and is figured in Plate 339, Fig. 74. It is said to have been introduced in 1786; but is apparently not in cultivation at present, and is probably unsuitable for our climate.

[2] Loudon only mentions one tree, which was growing in the Horticultural Society's garden at Chiswick.

This tree was discovered about 1830 by Mr. T. G. Lea near Cincinnati, Ohio, and has since been found scattered as isolated specimens over a wide area, extending from the district of Columbia and western North Carolina to southern Michigan, central and northern Illinois, and south-eastern Missouri. (A. H.)

The large tree near the Director's Office, Kew Gardens, which has long been labelled *Q. heterophylla*, appears to belong to this hybrid. It was probably planted by Sir W. J. Hooker, though its age and history are unknown. It measured in 1909 60 ft. high and 7½ ft. in girth. A smaller tree in the oak collection at Kew about 25 ft. high, obtained from Smith of Worcester in 1877 under the name *Q. villosa*, is very similar, and is certainly one of the hybrids of *Q. imbricaria*.

A tree was growing in 1903 at Devonshurst, Chiswick, formerly part of the Horticultural Society's garden, which Henry measured as 72 ft. by 6 ft. 8 in. It was cut down shortly afterwards.

At Ham Manor, Sussex, the seat of Sir H. Fletcher, there is a fine tree. When I measured it in June 1907 it was 62 ft. by 7 ft. 2 in., forking at 7 ft., and appeared to be grafted on a stock of the common oak, like the large one at Kew. A smaller tree also exists at Orton Hall. (H. J. E.)

## QUERCUS HETEROPHYLLA, Bartram's Oak

*Quercus heterophylla*, Michaux f., *Hist. Arb. Am.* ii. 87, t. 16 (1812); Loudon, *Arb. et Frut. Brit.* iii. 1894 (1838); Engelmann, in *Woods and Forests*, 1884, pp. 735, 736; Sargent, *Trees N. Amer.* 248 (1905).

*Quercus aquatica*, var. *heterophylla*, Aiton, *Hort. Kew.* v. 290 (1813).

*Quercus nigra*, var., Cooper, in *Smithsonian Rep.*, 1858, p. 255 (1859).

*Quercus Phellos* × *coccinea*, Engelmann, in *Trans. St. Louis Acad.* iii. 541 (1877).

*Quercus Phellos* × *velutina*, Sargent, *Silva N. Amer.* viii. 180, *adnot.*, t. 436 (1895).

*Quercus Phellos* × *rubra*; *Quercus Hollickii*, Schneider, *Laubholzkunde*, 165 (1904).

A tree, occasionally attaining 80 ft. in height. Young branchlets glabrous. Leaves (Plate 334, Fig. 16) deciduous, lanceolate or narrow-elliptic, acute at the apex, cuneate at the base, 3 to 6 in. long, 1 to 2 in. wide; with usually three to five pairs of triangular bristle-pointed lobes, separated by wide sinuate sinuses; glabrous on both surfaces, except for axil-tufts beneath; nerves pinnate, those ending in the apices of the lobes more prominent than the intervening nerves, which divide and loop before reaching the margin; petiole ½ to 1½ in. long, slightly pubescent.[1]

The above description is drawn up from a tree in Kew Gardens, about 30 ft. high, which was obtained from the Arnold Arboretum in 1877. Much variation, however, occurs in the shape of the leaves on wild trees, which are often only slightly lobed, and resemble those of *Q. Phellos*; but in all cases, as Engelmann points out,[2] the elongated petiole will serve to distinguish Bartram's oak from *Q. Phellos* or

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[1] The fruit, which I have not seen, is said to be sparingly produced on trees in America, and in some cases is like that of *Q. rubra*, and in other cases similar to that of *Q. velutina*.

[2] In *Woods and Forests*, 1884, pp. 735, 736.

*Q. nigra*, two species which have often lobed leaves on young trees and on vigorous barren branchlets of older trees. In these species the petioles are inconspicuous, or merely 1 to 2 lines long. *Q. imbricaria*, which has long petioles, is readily distinguished in all its forms and hybrids by the pubescent leaves.

This oak was first described from a solitary tree[1] growing on the farm of John Bartram, near Philadelphia, on the banks of the Schuylkill, where it was discovered at some time previous to 1750. What appears to be the same tree has since been discovered at a considerable number of stations[2] from New Jersey to Texas.

Much discussion has arisen as to the relationship of Bartram's oak, and of the individuals that have been found like it; and Engelmann, who had not, however, seen flowers or fruit, considered it to be a distinct species, and not a variety of either *Q. Phellos* or *Q. nigra*, nor a hybrid of any of these oaks. The hybrid origin of *Q. heterophylla* was, however, definitely settled by an experiment of Dr. D. T. MacDougal.[3] In October 1905 he collected seventy-five acorns from a tree growing on Staten Island, which had foliage similar to that of Bartram's oak; and fifty-five seedlings were obtained, which exhibited foliage of three kinds. Some of the seedlings had lanceolate entire leaves like those of *Q. Phellos*; others had broad lobed leaves like those of *Q. rubra*, while the remainder were intermediate and resembled the parent tree. In this case the parents may be assumed to be *Q. Phellos* and *Q. rubra*;[4] but in other cases, though one of the parents is almost certainly *Q. Phellos*, the other, judging from the fruit, may be *Q. coccinea* or *Q. velutina*.

This oak appears to be very rare in cultivation, the only specimen which we have seen in England being the tree at Kew, mentioned above. Loudon says: "Said to have been introduced, but we do not know where it is to be obtained." Older trees, bearing this name, are usually *Q. Leana*. There is, however, a large tree of *Q. heterophylla* at Les Barres,[5] about 66 ft. by 9 ft., which bears fruit regularly, but in small quantity, and is said to be very hardy. This tree was planted[6] in 1822. Another tree at Verrières,[6] probably of the same origin, but with slightly different foliage, measures 73 ft. by 8 ft., and bears a tuft of mistletoe on one of its large branches. (A. H.)

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[1] Otto of Berlin, in Loudon, *Gard. Mag.* xvii. 380 (1841), states that he saw *Q. heterophylla*, a tree 40 ft. high, growing in Bartram's botanic garden at Philadelphia, which was founded in 1717.

[2] A complete history of the occurrence of these trees is given by Arthur Hollick, in *Bull. Torrey Bot. Club.* xv. 303 (1888).

[3] Cf. *Bot. Gaz.* xliii. 49, figs. 2, 3 (1907). Mechan, in *Gard. Chron.*, 1866, p. 365, speaks of two seedlings from the original tree, one a perfect *Q. Phellos*, the other like *Q. heterophylla*.

[4] *Q. Hollickii*, Schneider, *loc. cit.*, who attempts to divide this form into three sub-varieties.

[5] Cf. Pardé, *Arb. Nat. des Barres*, 299 (1906).

[6] *Hortus Vilmorinianus*, 55 (1906). A specimen branch procured by Elwes shows imperfect acorns.

## QUERCUS NIGRA, Water Oak

*Quercus nigra*, Linnæus, *Sp. Pl.* 995 (1753); Sargent, *Silva N. Amer.* viii. 165, t. 428 (1895), and *Trees N. Amer.* 246 (1905); Britten,[1] in *Journ. Bot.* xlvii. 349 (1909).
*Quercus nigra aquatica*, Lamarck, *Encyc.* i. 721 (1783).
*Quercus uliginosa*, Wangenheim, *Nordam. Holz.* 80, t. 6, f. 18 (1787).
*Quercus aquatica*, Walter, *Fl. Car.* 234 (1788); Loudon, *Arb. et Frut. Brit.* iii. 1892 (1838).
*Quercus hemisphærica*, Willdenow, *Sp. Pl.* iv. 443 (1805).

A tree, attaining in America 80 ft. in height and 10 ft. in girth. Bark about ½ in. thick, covered with closely appressed scales. Young branchlets slender, glabrous. Leaves (Plate 334, Fig. 9) deciduous, late in the season, very variable in shape and size; on old trees obovate or oval, cuneate at the base, and enlarged at the broad, rounded, entire or three-lobed apex, about 3 in. long and 2 in. broad at the widest part; on vigorous and sterile branches on young trees longer and narrower, about 4 in. long by 1 in. broad, acute at the apex, cuneate at the base, with three to seven short triangular oblique bristle-pointed lobes; thin, membranous, glabrous, except for axil-tufts beneath; petiole short, ⅛ to ¼ in. long.

Fruit solitary, short-stalked, ripening in the second year; acorn broad and flat at the base, rounded at the pubescent apex, enclosed for one-fourth its length in a thin saucer-shaped cupule,[2] about ½ in. wide, tomentose within, and covered with ovate acute appressed pubescent scales.

The Water Oak, as its name implies, grows naturally on moist alluvial ground, and on the sandy borders of swamps and streams; and ranges from southern Delaware southward to Cape Malabar and the shores of Tampa Bay, Florida, extending inland to the base of the southern Alleghany Mountains, and westward through the Gulf states to the Colorado river, Texas, and the eastern part of Indian Territory, ascending the Mississippi basin to Arkansas, south-eastern Missouri, central Tennessee and Kentucky. On account of its rapid growth when young, and the facility with which it can be transplanted, it is used extensively as a shade tree in the cities and towns of the southern States.

According to Loudon, it was cultivated in England in Fairchild's nursery as early as 1723. Like many other interesting trees, it has scarcely been planted in this country of late years, though it is worthy of a place in all collections on account of the long persistence of the leaves, which remain fresh and green on the specimens at Kew and Tortworth till January or February, or even later in some seasons. Apparently this species does not produce fruit in England; but we have received a specimen with fully developed acorns from Mlle Ivoy, Geneste, near Bordeaux.

(A. H.)

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[1] Britten, in the article quoted, explains how the name *Q. nigra*, L., was erroneously transferred at an early date to *Q. marylandica*. The proper usage of the names for these two oaks was restored by Sargent.

[2] *Q. microcarya*, Small, *Flora S. East. States*, 350 (1903), is a form with smaller acorns, surrounded by a cup-shaped and not saucer-shaped cupule. This was found growing on granite rocks on the Little Stone Mountain in Georgia.

There are several good specimens in Kew Gardens, the largest being a tree near the main entrance, which measured, in 1909, 49 ft. by 4 ft. 5 in. This tree belonged to the old arboretum, and must be older than 1841.

At Beauport, Sussex, a tree, seen by Henry in 1904, measured nearly 50 ft. in height by 3 ft. 11 in. in girth. Another at Lyndon Hall (Plate 312) is 56 ft. by 4½ ft. There is also a smaller tree on the lawn at Tortworth. (H. J. E.)

## QUERCUS MARYLANDICA, Black Jack

*Quercus marylandica*, Muenchhausen, *Hausvater*, v. 253 (1770); Sargent, *Silva N. Amer.* viii. 161, t. 426 (1895), and *Trees N. Amer.* 245 (1905); Britten, in *Journ. Bot.* xlvii. 351 (1909).

*Quercus nigra*, var. β, Linnæus, *Sp. Pl.* 996 (1753).

*Quercus nigra*, Wangenheim, *Beschreib. nordam. Holzart.* 133 (1781); Walter, *Fl. Carol.* 234 (1788); Michaux, *Hist. Chênes Am.* No. 12, tt. 22, 23 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1890 (1838) (not Linnæus).

*Quercus nigra latifolia*, Lamarck, *Encyc.* i. 721 (1783).

*Quercus ferruginea*, Michaux f., *Hist. Arb. Am.* ii. 92, t. 18 (1812).

A tree, attaining in America 50 ft. in height and 5 ft. in girth, but usually considerably smaller. Bark about an inch thick, divided into dark brown or nearly black, scaly, square plates. Young branchlets at first covered with a short stellate pubescence, gradually disappearing in the course of the summer; branchlets of the second year glabrous. Buds ovoid, ¼ in. long, covered with rusty brown pubescence. Leaves (Plate 334, Fig. 11) deciduous, averaging 5 to 7 in. in length and breadth, thick and coriaceous, very variable in shape, obovate, with a narrow rounded base, (*a*) with the apex broad, rounded, and indistinctly three-lobed or entire, with or without bristles, or (*b*) with the upper part of the leaf divided into three large oblong lobes, each with one to three bristle-pointed teeth; upper surface dark shining green, with quickly deciduous scattered minute stellate hairs; lower surface often brownish, with numerous stellate hairs in dense tufts in the axils and along the midrib and lateral nerves; petiole stout, ½ in. long, covered with short stellate hairs.

Fruit ripening in the second year, solitary or in pairs, shortly stalked; acorn sub-globose, ¾ in. long, with the shell lined with dense yellowish tomentum, enclosed for ⅓ to nearly ⅔ its length, in a thick turbinate cupule, covered by loosely imbricated tomentose scales.

This species usually grows on dry sandy barren land, though occasionally it is seen in the south-west on heavy clay soil; and is widely distributed in the United States, from Long Island, New York, southward to Tampa Bay, Florida, and westwards to south-eastern Nebraska, central Kansas, Indian Territory, and the valley of the Nueces river, Texas. Rare or local and poorly developed in the northern part of its range, it is abundant southward, often forming west of the Mississippi, a great part of the forest growth on sterile soils, and attaining its largest size in southern Arkansas and eastern Texas. (A. H.)

This tree, though introduced, according to Loudon, sometime before 1739, is rare in cultivation, and is usually short-lived in our climate. It scarcely attains the dimensions of a forest tree, but is worth a place in collections, on account of the large and curiously shaped leaves, which turn a brownish colour in autumn. It seldom has a healthy appearance, owing to the failure of the wood to ripen in autumn, and should be planted on a dry sandy soil in a warm and sheltered situation.

The largest tree we have seen is one at Lyndon Hall, Rutland, 40 ft. by 4½ ft. in 1908. There are younger trees at Tortworth, Bicton, Aldenham, and Kew.

(H. J. E.)

## QUERCUS CUNEATA, Spanish Oak

*Quercus cuneata*, Wangenheim, *Nordam. Holzart.* 78, t. 5, f. 14 (1787); Sargent, in *Bot. Gaz.* xliv. 226 (1907).

*Quercus rubra*, var. *hispanica*, Castiglioni, *Viag. Stati Uniti*, ii. 347 (1790).

*Quercus falcata*, Michaux, *Hist. Chênes Am.* No. 16, t. 28 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1882 (1838).

*Quercus triloba*, Michaux, *Hist. Chênes Am.* No. 14, t. 26 (1801).

*Quercus elongata*, Willdenow, in *Neue Schrift. Gesell. Natfr. Berlin*, iii. 400 (1801).

*Quercus discolor*, Spach, *Hist. Vég.* xi. 163 (1842) (not Aiton).

*Quercus nigra digitata*, Marshall, *Arb. Am.* 121 (1785).

*Quercus digitata*, Sudworth, in *Garden and Forest*, v. 98 (1892); Sargent, *Silva N. Amer.* viii. 147, tt. 420, 421 (1895), and *Trees N. Amer.* 242 (1905).

A tree, attaining in America 80 ft. in height and 9 ft. in girth. Bark divided by shallow fissures into broad scaly ridges. Young branchlets covered with a dense short stellate pubescence. Buds ovoid, ⅛ to ¼ in. long, with ciliate scales. Leaves (Plate 334, Fig. 14) deciduous in autumn, about 5 to 7 in. long and 3 to 4 in. wide, variable in shape; either (*a*) cuneate at the base, and divided into three large bristle-pointed lobes above, the terminal lobe longest and oblong, the lateral lobes shorter and ovate, each lobe entire or with one or two teeth; or (*b*) rounded or cuneate at the base, oblong-obovate, pinnately divided into five or seven entire or dentate, ovate, bristle-pointed lobes; upper surface dark green, shining, glabrescent; lower surface densely covered with dull grey minute stellate tomentum; petiole ¾ to 1 in. long, tomentose.

Fruit[1] ripening in the second year, sessile or shortly stalked; acorn sub-globose or ellipsoid, about ½ in. long, enclosed in a saucer-shaped or a deep turbinate cupule, covered with thin obtuse closely appressed scales.

This oak,[2] which was named Spanish oak by the early settlers from a fancied resemblance probably to *Q. Cerris*, is an abundant tree on dry sterile hills in the south Atlantic and Gulf states, extending as far westward as the Bragos river, Texas, and ascending the Mississippi basin, through Arkansas, Missouri, Tennessee, and Kentucky to southern Indiana and Illinois. It is rare in the north Atlantic states, where it is only met with near the coast, reaching its most northerly point in southern New Jersey. It is one of the trees which grows, but not in great abundance, in the southern maritime pine belt.

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[1] The small trees in England have not produced fruit. This species ripens its fruit at Geneste, near Bordeaux.

[2] *Q. pagodæfolia*, Ashe, in *Bot. Gaz.* xxiv. 375 (1897); Sargent, *Silva N. Amer.* xiv. 51, t. 722 (1902), and *Trees N. Amer.* 244 (1905), was formerly considered to be a variety of *Q. cuneata*, from which it differs in the bark and in the shape of the leaves (see Plate 334, Fig. 12), which are always silvery white beneath. Specimens were gathered by Elwes in 1904 at Mt. Carmel, Illinois; but the tree has not yet been introduced. It has much the same distribution as *Q. cuneata*, but is always found in rich land along rivers liable to floods, whereas *Q. cuneata* is confined to the dry uplands. It is very abundant in the river swamps of the Yazoo basin, Mississippi, and of eastern Arkansas.

This is the form mentioned by Ridgway as a rare tree in the bottoms of the White River, where he measured a specimen 14 ft. in girth and estimated at 130 ft. high. It is unlikely to succeed in Great Britain.

This species was introduced in 1763 by Mr. Murdoch Murchison, and re-introduced in 1800 by Messrs. Fraser. It is extremely rare in cultivation, the only trees which we have seen being two in Kew Gardens, about 25 feet high, which are vigorous and healthy; and a small specimen at Aldenham. (A. H.)

## QUERCUS ILICIFOLIA, BEAR OAK

*Quercus ilicifolia*, Wangenheim, *Nordam. Holzart.* 70, t. 6, f. 17 (1787); Loudon, *Arb. et Frut. Brit.* iii. 1893 (1838); Sargent, in *Bot. Gaz.* xliv. 227 (1907).

*Quercus Banisteri*, Michaux, *Hist. Chênes Am.* No. 15, t. 27 (1801).

*Quercus rubra nana*, Marshall, *Arbust. Am.* 123 (1785).

*Quercus nana*, Sargent, in *Garden and Forest*, viii. 93 (1895), *Silva N. Amer.* viii. 155, t. 424 (1895), and *Trees N. Amer.* 241 (1905).

A shrub or small tree, scarcely exceeding 20 ft. in height. Bark thin and scaly. Young branchlets covered with a minute dense pubescence, glabrous in the second year. Buds minute, ovoid, obtuse, glabrous, ⅛ in. long. Leaves (Plate 334, Fig. 13) deciduous, about 3 in. long and 2 in. wide, coriaceous, obovate-oblong, cuneate at the base; divided by wide shallow sinuses into five short broad bristle-pointed acute lobes, the terminal lobe usually largest and often with one or two teeth; upper surface dark green, shining, with quickly deciduous minute stellate pubescence; lower surface greyish tomentose; petiole slender, ½ in. long, tomentose.

Fruit ripening in the second year, sessile or stalked; acorn ovoid, about ½ in. wide and long; cupule thick, turbinate, covered with closely appressed, thin, slightly pubescent scales, the minute free tips of the upper rank forming a fringe.

This species grows on dry sandy barren ground and on rocky hill-sides from Maine to eastern Pennsylvania, and along the Alleghany mountains to southern Virginia.

This oak was discovered in Virginia by the missionary John Banister, and was included in his catalogue of Virginian plants published by Ray[1] in 1688. It was introduced in 1800 by Messrs. Fraser, and is a thriving shrub at Tortworth, where it produces acorns freely; and is possibly of some value on that account for planting in game coverts as food for pheasants. There are specimens also at Kew, Westonbirt, and Liphook. At Les Barres in France it grows vigorously, and sows itself, being looked upon as good pheasant covert. (A. H.)

[1] Ray, *Hist. Plant.* ii. pp. 1926-8. It was called *Q. pumila* by Banister.

## QUERCUS VELUTINA, Black Oak, Quercitron Oak

*Quercus velutina*, Lamarck, *Dict.* i. 721 (1783); Sargent, *Silva N. Amer.* viii. 137, tt. 414, 415 (1895), and *Trees N. Amer.* 237 (1905).

*Quercus nigra*, Du Roi, *Harbk. Baumz.* ii. 272 (excl. syn.), t. 6, f. 1 (1772) (not Linnæus).

*Quercus discolor*, Aiton, *Hort. Kew.* iii. 358 (1789).

*Quercus tinctoria*, Michaux, *Hist. Chênes Am.* No. 13, tt. 24, 25 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1884 (1838); Bentley and Trimen, *Med. Plants*, iv. 251, t. 251 (1880).

*Quercus coccinea*, Wangenheim, vars. *nigrescens* and *tinctoria*, A. de Candolle, *Prod.* xvi. 2, p. 61 (1864).

A tree, attaining in America 150 ft. in height and 15 ft. in girth, but usually considerably smaller. Bark of young trees smooth, yellowish within; on old trunks divided into broad rounded scaly ridges. Buds ovoid, ⅛ to ¼ in. long, angled, obtuse or pointed, pubescent. Young branchlets, with a scattered minute stellate pubescence, most of which falls off in summer. Leaves (Plate 333, Fig. 5) deciduous in autumn, turning a dull red or dark brown, variable in size and shape, but similar to those of *Q. rubra*, often very large, 9 in. long and 6 in. broad, with five to seven triangular lobes with bristle-pointed teeth; sinuses wide and rounded, variable in depth; upper surface glossy, dark green, with scattered stellate hairs, disappearing in summer; lower surface paler, with stellate hairs scattered between the nerves, and forming dense reddish brown axil-tufts; petiole 1 to 3 in. long, with deciduous or partly persistent stellate pubescence. The inner bark of young branches is bitter when chewed, and gives a yellow tinge to the saliva.

Fruit ripening in the second year, sessile or shortly stalked, solitary or in pairs; acorn[1] ovoid, ½ to ¾ in. long, often striated, and sometimes pubescent, enclosed for about half its length in a turbinate cupule, slightly pubescent within, and covered with scales, often lacerate in margin, closely appressed towards the base of the cupule, loosely imbricated above, forming a fringe-like border to its rim.

This species is readily recognised by the bright yellow colour of the inner bark, by the more or less deciduous stellate pubescence on the leaves, petioles, and branchlets, and by the pubescent buds.

Var. *missouriensis*, Sargent, *Trees N. Amer.* 239 (1905), is a more pubescent form, growing in drier situations from western Missouri to north-western Arkansas.

The black oak grows commonly on ridges and on dry gravelly uplands, and is one of the most abundant and widely distributed of North American oaks. It occurs in southern and western Ontario, and throughout the Atlantic States from southern Maine to northern Florida, being one of the commonest oaks on gravelly drift in southern New England and in the middle states; and is generally scattered throughout the maritime pine belt of the south Atlantic coast and of the Gulf states, extending westward to eastern Texas, Indian Territory, eastern Kansas, south-eastern Nebraska, Iowa, and central Minnesota. It forms a large part of the forest growth on the foothills of the southern Alleghany mountains, and is abundant in all parts of the Mississippi basin, attaining its largest size in the valley of the lower Ohio river. (A. H.)

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[1] The flesh of the acorn is orange in colour.

### REMARKABLE TREES

This species was introduced, according to Loudon, in 1800; but is much less commonly seen than *Q. rubra*; and though it appears to grow well in southern England, it rarely ripens its acorns.

The finest tree which we know of is growing at Bayfordbury (Plate 313), where it was planted in 1841 under the name *Q. rubra macrophylla*. It was 80 ft. high by 6 ft. 10 in. in girth in 1905.

At Arley Castle there are two fine trees,[1] planted probably about 1820, one of which measured in 1903, 80 ft. by 7 ft. 2 in.; the other, in the following year, was 70 ft. by 6 ft. 6 in.

At Beauport, a tree growing in a rather crowded position, and apparently decaying at the top, is from 60 to 65 ft. in height, and 7 ft. 3 in. in girth. At Lyndon Hall, Rutland, the seat of E. W. P. Conant, Esq., there are two trees, the larger nearly 50 ft. high and 5 ft. 3 in. in girth. At Henham Hall, Suffolk, the seat of the Earl of Stradbroke, there is a tree, measuring in 1909, 53 ft. by 5½ ft. There are also specimens at Syon, Kew, and Tortworth, where it was found labelled *Q. nigra*; and at Liphook, Westonbirt, and Orton Hall.

In the south-west it seems to grow well, as there are healthy trees at Killerton, about 50 ft. by 5 ft. in 1906, and a smaller one at Bicton. At Pixton Park there is a fine tree in the park by the Dulverton Drive, which in 1909 was about 60 ft. by 5 ft. 4 in.

In Scotland, the only tree we know of is one at Castle Kennedy, which Henry found in 1906, bearing the name of *Q. macrocarpa*.

### TIMBER AND BARK

Its timber is said by Michaux to be the best of the oaks of this section, but is not distinguished in commerce, and judging from the examples in Hough's work, is very similar in appearance to that of *Q. rubra*. It is largely used for staves and furniture.

The bark is extensively used for tanning, and gives a valuable yellow dye known as *quercitron*, which, according to Loudon, is equal to weld[2] in the brilliancy of the yellow which it gives, and was at that time largely imported in England. According to Bentley and Trimen, it is used in Europe for dyeing silk and wool. (H. J. E.)

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[1] Cf. R. Woodward, Jun., *Hortus Arleyensis*, 11, 46 (1907).

[2] Loudon says "woad," evidently a mistake for "weld," *Reseda Luteola*, which yields a yellow dye, much used formerly.

## QUERCUS KELLOGGII, CALIFORNIAN BLACK OAK

*Quercus Kelloggii*, Newberry, in *Pacific R. R. Rep.* vi. 28, f. 6 (1857); Sargent, in *Bot. Gaz.* xliv. 226 (1907).

*Quercus tinctoria*, Michaux, var. *californica*, Torrey, in *Pacific R. R. Rep.* iv. part i. 138 (1856).

*Quercus rubra*, Bentham, *Pl. Hartweg.* 337 (1857) (not Linnæus).

*Quercus californica*, Cooper, in *Smithsonian Report*, 1858, p. 261 (1859); Sargent, *Silva N. Amer.* viii. 141, t. 416 (1895), and *Trees N. Amer.* 239 (1905).

*Quercus sonomensis*, A. de Candolle, *Prod.* xvi. 2, p. 62 (1864).

A tree, occasionally attaining 100 ft. in height and 12 ft. in girth, frequently smaller, and at high elevations becoming a shrub. Bark of young trees smooth; on old trunks divided into thick irregular oblong scaly plates. Young branchlets quickly becoming glabrous. Buds ovoid, pointed, ¼ in. long, pubescent at the tip; scales pale brown, with dark brown ciliate margins. Leaves (Plate 333, Fig. 2) deciduous in autumn, turning yellow or brown before falling, 3 to 6 in. long, 2 to 4 in. broad, oblong or obovate, with usually seven (rarely five or nine) oblong lobes with bristle-pointed teeth; sinuses usually deep, narrow, and rounded at the base; upper surface shining, glabrous, dark green; lower surface paler, with scattered minute stellate pubescence, and without axil-tufts; petiole about 1 in. long, quickly becoming glabrous.

Fruit, ripening in the second year, solitary or clustered on short stout stalks; acorn ovoid, about an inch long, pubescent; enclosed for about half its length in a deep cupule, covered by thin ovate-lanceolate slightly pubescent scales, which in the lower ranks are closely appressed and swollen on the back, and towards the rim of the cupule are loosely imbricated with thin erose margins.

*Q. Morehus*, Kellogg, in *Proc. Calif. Acad.* ii. 36 (1863); Sargent, *Silva N. Amer.* viii. 120, t. 407 (1895); a small tree with subevergreen foliage, occurring in a few localities in California, is believed to be a hybrid between *Q. Kelloggii* and the evergreen *Q. Wislizeni.*

*Q. Kelloggii* is a native of Oregon and California, where it ranges from the basin of the Mackenzie river in western Oregon southwards through the coast ranges and along the western slopes of the Sierra Nevada to the San Bernardino, San Jacinto and Cuyamaca mountains, attaining towards the south 7000 to 8000 ft. altitude. It is mainly found in valleys and on mountain slopes, and is rare in the immediate vicinity of the ocean.

I saw this species in 1906, at about 3000 ft. elevation, on the dry hills of the Siskiyou range, where it is associated with *Q. Garryana*, one of the Californian white oaks. Both species attained about 70 ft. in height with short trunks up to 4 ft. in diameter, dividing into wide-spreading branching limbs. The bark of *Q. Kelloggii* is rather dark in colour, contrasting strongly with the remarkably white bark of the other species. Mr. F. R. S. Balfour, who visited the same district, saw larger trees in the valley of the Illinois river, Oregon, and in the

King's river cañon in California, where their trunks rose tall and straight amongst *Libocedrus decurrens* and *Pinus ponderosa.* In late autumn the foliage turns to fine yellow and crimson colours.

This tree was discovered by Hartweg in 1846 near Sonoma, among the foothills of the Californian Sierras; and is named after Dr. Albert Kellogg, the pioneer botanist of California, who was one of the founders of the Californian Academy of Sciences, and Curator of the Herbarium in San Francisco. According to Lemmon,[1] it is generally known as the Kellogg oak.

This species is little known in cultivation; and Schneider doubts if it exists on the continent. It appears to have been first introduced by the Earl of Ducie, who has at Tortworth two fine specimens about 30 ft. high by 2 ft. 3 in. which were raised from acorns obtained from San Francisco in 1878. These are making rapid growth.

There is a smaller specimen at Kew which ripened acorns in 1907.

(A. H.)

## QUERCUS RUBRA, Red Oak

*Quercus rubra*, Linnæus, *Sp. Pl.* 996 (1753); Michaux, *Hist. Chênes Am.* No. 20, tt. 35, 36 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1877 (1838); Sargent, *Silva N. Amer.* viii. 125, tt. 409, 410 (1895), and *Trees N. Amer.* 230 (1905).

A tree, attaining in America 150 ft. in height and 12 ft. in girth. Bark on young trees smooth, thin, grey; becoming on old trunks about an inch in thickness and divided on the surface into small scaly plates. Young branchlets glabrous, dark red, with white lenticels. Buds ovoid, acute, about ¼ in. long, reddish brown, often pubescent at the tip; scales glabrous, with ciliate margins. Leaves (Plate 333, Figs. 3 and 8) deciduous, membranous, 5 to 8 in. long, 4 to 6 in. broad, oval or obovate, cuneate or rounded at the base, acute or acuminate at the apex, usually divided about half-way to the midrib, by wide oblique sinuses, into seven to eleven ovate or triangular lobes, broad at the base, and with one to three bristle-pointed teeth at the apex; upper surface dark green, glabrous; lower surface dull or pale green, glabrous, except for slight axil-tufts of pubescence; petiole 1 to 2 in. long, glabrous.

Fruit ripening in the second year, solitary or in pairs, sessile or stalked; acorn ovoid, ¾ in. to 1 in. long, broad at the base, rounded at the apex, enclosed only at the base in a thick, shallow, saucer-like cupule, ¾ in. to 1 in. in diameter, pubescent within, and covered externally with closely appressed, thin, ovate, minutely pubescent scales.

The red, scarlet, and pin oaks are often confused; but may readily be distinguished by the characters of the buds and leaves, given for each species in the Key, Nos. 14, 15, and 16. See also, under *Q. coccinea*, p. 1248, and *Q. palustris*,

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[1] *Oaks of Pacific Slope*, 14 (1902).

p. 1250. Both *Q. rubra* and *Q. palustris* have saucer-like or flat acorn-cupules, those of the former being large and thick; those of the latter species thin and small. The cupules of *Q. coccinea* are deep and turbinate, with a peculiar scaly stalk.

### DISTRIBUTION[1]

The red oak is one of the largest and most common trees in the eastern parts of Canada and the United States. It is abundant in southern Nova Scotia, New Brunswick, Quebec, and Ontario, and in the northern and central States, attaining its largest size in the region north of the Ohio river. Its western limit is marked by a line drawn from lake Namekagon in Burril County, Wisconsin, through eastern Minnesota, eastern Nebraska, and the Blue river in Kansas. Its southern and south-western limits are not clearly defined, as it is replaced to the southward by *Q. Schneckii*, which has hitherto been generally confounded with it. Its occurrence in Indian Territory, eastern Texas, southern Missouri and Arkansas is doubtful. It is common in the mountainous parts of Kentucky and Tennessee, and reaches its most southerly point, so far as is known, in the Red Mountains near Birmingham, Alabama, where a few isolated stunted specimens have been found. On the Atlantic slope it is common everywhere in New England, except in the mountains, in New York outside the Adirondacks, and throughout New Jersey and Pennsylvania. Farther south it extends along the Alleghanies as far as northern Georgia. Towards the north it is confined to altitudes below 500 ft., in Kansas and Missouri below 1000 ft., while in Virginia it ascends to 3500 ft., and in western North Carolina to 5000 ft.

The red oak thrives best where the rainfall is considerable, 32 to 53 in. annually being registered over its area of distribution. It ceases to grow west of the 90th meridian, where the rainfall falls below 30 in. The climate in which it flourishes is characterised by great extremes of temperature, the thermometer often falling during the long winter to – 30° Fahr., and attaining in summer a maximum of 90° to 95° Fahr. It grows well on porous sandy, or on gravelly clay soils, which are well-drained; and is not found on very wet or on very dry ground. It is intolerant of shade, except when quite young. It is not subject to disease or serious insect attacks, and is rarely overthrown by the wind.

In the forest it is usually associated with numerous other species, as other kinds of oak, chestnut, lime, elms, and hickories; and where the canopy is dense and a good layer of humus exists attains a greater height than any other American oak, and in a shorter time, trees 150 ft. high and 5 ft. in diameter being not uncommon in favourable situations; but on drier and poorer soil it does not exceed 100 ft. The stems of forest-grown trees are usually buttressed at the base, and are exceptionally straight and of uniform diameter, and are often free of branches to 40 or 50 ft. The red oak, on account of its abundance over a wide area, and its rapidity of growth, producing timber of commercial value quicker than any other black oak, takes a prominent place among the supplies of hardwood timber east of the Mississippi river, particularly in their northern area.

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[1] Compiled in part from notes by Professor C. Mohr, in the Bureau of Forestry, Washington, D.C.

Isolated trees in the open in Massachusetts do not appear to attain as great a height as they do in England, those mentioned[1] as noteworthy for size being the Charlemont oak, 58 ft. by 14½ ft., the Beaman oak, 70 ft. by 17 ft. 8 in. The Caster oak, the height of which is not stated, growing at Lancaster in this state is 18 ft. 5 in. in girth.

The red oak reproduces freely from coppice shoots, which often attain 6 ft. in their first season. Where natural regeneration cannot be relied on, or where new land is being planted, in America, acorns are sown *in situ*, as the seedling is not easy to transplant, on account of its long tap-root. (A. H.)

## CULTIVATION

The red oak has been tried as a forest tree on a considerable scale on the Continent. In Prussia[2] the area under cultivation at thirty-two different experimental stations was about 100 acres in 1900; and it has shown very rapid growth in youth, averaging 7 to 10 ft. high at five years old, 16 to 25 ft. at ten years old, 25 to 35 ft. at fifteen years, and 40 to 50 ft. at twenty years. It succeeds well on poor land, thriving even on soil considered to be third class for growing the common pine. It is used for underplanting pine woods, and for filling up gaps in broad-leaved plantations.

In Belgium thousands of trees of this species have been planted with the greatest success. Wesmael[3] reported in 1890, that trees forty-five years old had attained on an average a height of 60 ft. and a girth of 5 ft. 11 in. He claimed for the tree that the wood was excellent for carriage-building and cabinet-work, and that it grew well on light porous soil, where the common European oak remained dwarfed and stunted. At Tervueren near Brussels M. Bommer showed me in 1909 a plantation of red oaks thirty years old, on fairly good sandy soil, the average height of which was about 50 ft., and the average girth 16 to 24 in. They formed a good cover with straight clean stems, and had recently been underplanted with beech.

Introduced into France as long ago as 1740, and grown by Miller in England in 1739, the red oak is the best known and the most generally successful of the American oaks in England. It ripens its acorns in the south, and self-sown seedlings are occasionally found on the warm light soils which it requires to enable it to become a large tree. It does not, however, seem to be a very long-lived tree, most of the oldest which we have seen already showing signs of decay.

The colour of its foliage in autumn is so beautiful that it should be planted in conspicuous places in all pleasure-grounds and parks, and if sheltered by other trees when young, and on deep well-drained soil, it grows rapidly and soon produces the best effect among other foliage. I have raised seedlings from a tree in Lord Ducie's park, which grow fairly well on my soil, but like all American oaks, require good nursery cultivation when young.

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[1] In *Garden and Forest*, iv. 586 (1891).

[2] Schwappach, *Anbauvers. fremdl. Holzart.* 72 (1901).

[3] Cf. *Garden and Forest*, iii. 129 (1890).

### REMARKABLE TREES

The largest that we have seen in England is a tree at Pains Hill on the edge of a belt near the kitchen garden, in light sandy soil. In 1908 this measured about 80 ft. high by 19 ft. in girth, with a short bole, and branches spreading over an area 38 yds. wide. Some self-sown seedlings were coming up near it. At Kew there is a fine old tree[1] near the Pagoda, which in 1909 was about 75 ft. by 13½ ft. with a bole 20 ft. high. This tree a few years ago was decaying, but its vigour has been much increased by cutting out the dead branches, and top-dressing the roots with good soil.[2] The tallest trees that I have measured are one at Oakly Park, Ludlow, which in 1908 was about 100 ft. by 11½ ft., and one at Brockett Hall, Herts, which in 1905 was 97 ft. by 8½ ft. At Cassiobury in the same county, Henry measured a fine tree in 1904, 90 ft. by 14½ ft. with a clean bole about 20 ft. long. At Whitton there is a tree, probably 150 years old, which in 1903 was 90 ft. by 7 ft. 10 in., with a trunk 40 ft. high.

In the midland counties the best specimens we have seen are at Coombe Abbey, 85 ft. by 11 ft. 9 in. in 1908, and on the lawn at Kedleston, near Derby, a well-shaped tree (Plate 314) measuring in 1909, 90 ft. by 11 ft. with a bole of 30 ft.

In the south-western counties there are good-sized trees at Melbury and at Endsleigh. At Pixton Park, Dulverton, the seat of the Dowager Countess of Carnarvon, there are several fine tall trees in a wood called Puzzlecombe, the best of which was, as nearly as I could estimate, about 100 ft. high, with a clean straight trunk nearly 60 ft. high.

In Wales the finest known to us is at Stackpole Court, which in 1906 was about 90 ft. by 9½ ft. At Margam there is also a good-sized tree of this species. Besides the above we have seen and measured red oaks in a great many other places, many of which are known as scarlet oaks.

In Scotland it has not been planted as generally as in England, but succeeds well in those parts which have a warm summer. The best that I know of are at Brahan Castle, Ross-shire, which was about 80 ft. by 7½ ft. in 1907; and at Murthly, where there are several good trees, 70 to 80 ft. high, in the Birnam Drive. These bore no acorns in 1906, and the forester told me that the leaves were much eaten by the larva of *Tortrix viridana*, which I have noticed also in England.

In Ireland it is comparatively scarce, the largest we have measured about 60 ft. by 7 ft. 8 in. in 1909, being in the Lakeside Drive at Muckross, Killarney. A specimen from a tree at Carton, Maynooth, measuring 50 ft. by 8 ft. 3 in. is preserved in the Kew Herbarium.

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[1] This tree bears a single branch, with leaves creamy-white in colour. Efforts to propagate this shoot were not successful.

[2] A similar instance of the regeneration of the American white oak is shown by Prof. Sargent in two illustrations of a tree in the Arnold Arboretum, one taken before its treatment, the other twelve years afterwards, and the results are certainly very striking.

On the Continent it succeeds even better than in England, and is commonly planted in the parks and pleasure grounds of France, Germany, and Belgium. The largest tree I have seen is at the Château de Longchamps in Belgium, where Baron de Selys Longchamps showed me a splendid tree grafted on the common oak at about 4 ft. from the ground, and measuring no less than 110 ft. by 12 ft. in 1908.

### TIMBER

Though the wood of this tree is not highly valued in the United States in comparison with that of the white oak, on account of its want of durability, yet for interior work it seems a good timber, on account of its delicate pinkish colour and handsome silver grain when quartered. Owing to the increased scarcity of white oak it is now largely imported to this country, and often mixed with parcels of boards of other species and sold as American oak. So little is known about its true qualities, that at a recent trial in London, an architect stated in evidence that it was grown in swamps and was subject to dry rot. The former statement is certainly incorrect, and for the latter we can find no foundation; though no doubt badly-seasoned wood of this tree would rot like any other if put into damp buildings. The wood of a tree which was grown at Woolbeding in Sussex, and kindly given me by Archdeacon Elwes, was very easy to rend on account of its straight grain, and had the same pink tinge as the American-grown wood.

We abstract the following from a paper by Prof. Mohr:[1] The heartwood of the red oak is reddish, porous, and of coarse grain. The wide pores in the cross-section mark the annual rings in three or four rows. The medullary rays are conspicuous, but comparatively few. The wood is heavy, strong, and hard, inclined to shrink and check when drying. The structure of the wood not being homogeneous, the wood in drying parts with its moisture unequally, the water being retained in some parts much more than in others. The wood thus retains moisture, and when dried readily reabsorbs moisture; and this explains its liability to decay. In strength the wood is scarcely inferior to white oak, but its want of durability prevents its application for many purposes. Perfectly dried red oak has a specific gravity averaging 0·652, varying from 0·540 to 0·748; and a cubic foot of air-dry wood weighs 40·75 lb. In its mechanical properties, it compares favourably with the more valuable hardwoods. In its resistance to longitudinal compression, it is equal to white oak. In elasticity it surpasses white oak; and in ultimate strength (resistance to transverse pressure) it is slightly superior to white oak. In hardness, *i.e.* resistance to indentation, it falls far below white oak; and this want of hardness renders red oak unfit for cross-ties. Nails exposed to its acid watery juice easily rust, and this sometimes prevents its use in construction.

The wood is very desirable for interior finish and furniture. When sawn on the quarter it has a beautiful grain, and is little less valuable than white oak for cabinet-work.

Red oak timber has been used extensively from the time of the earliest settlements for clap-boards, for the interior finish of houses, and for dry cooperage. Of late years it had been increasingly used for making a cheap class of furniture, as chairs, tables, and other articles. Its very objectionable defect, that of shrinking and checking badly when drying, has been in a large degree overcome by treatment in the dry kiln. Its additional uses are: shipbuilding (to a limited extent), house-building, agricultural implements, baskets, wood alcohol, acetate of lime, and shingles. (H. J. E.)

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[1] MS. in the Bureau of Forestry, Washington, D.C.

## QUERCUS COCCINEA, Scarlet Oak

*Quercus coccinea*, Muenchhausen, *Hausv.* v. 254 (excl. *b*) (1770); Loudon, *Arb. et Frut. Brit.* iii. 1879 (1838); Sargent, *Silva N. Amer.* viii. 133, tt. 412, 413 (1895), and *Trees N. Amer.* 236 (1905).

A tree attaining in America 80 ft. in height and 10 ft. in girth. Bark smooth and thin on young trees; on old trunks divided by shallow fissures into scaly ridges. Young branchlets shining, glabrous, with white lenticels. Buds ovoid, acute, ⅛ to ¼ in. long, covered above the middle with whitish pubescence. Leaves (Plate 333, Fig. 6)[1] deciduous late in autumn, turning brilliant scarlet before they fall, 3 to 6 in. long, 2½ to 4 in. broad, obovate or oval, very variable in shape, as a rule more deeply lobed than *Q. rubra*, the sinuses often extending to near the midrib; usually with seven to nine spreading oblong, often falcate lobes, each with two to five bristle-tipped teeth towards the apex; base truncate or cuneate; shining and glabrous on both surfaces, except for occasional inconspicuous axil-tufts beneath; petiole slender, glabrous, 1½ to 2½ in long.

Fruit ripening in the second year, solitary or in pairs, sessile or short-stalked; acorn ½ to ¾ in. long, ovoid, rounded at the base and apex; enclosed for half its length in a deeply turbinate thin cupule, ½ to ¾ in. broad at the rim, covered with closely appressed ovate acute slightly pubescent scales. The base of the cupule is formed by a narrow prolongation, resembling a thickened stalk, but differing from a true peduncle in being covered with scales.

*Quercus ambigua*, Michaux f., *Hist. Arb. Am.* ii. 120, t. 24 (1812); Loudon, *Arb. et Frut. Brit.* iii. 1881 (1838).

*Quercus borealis*, Michaux f., *N. Amer. Sylva*, i. 98, t. 26 (1819); Britton, *Man. Fl. N. States*, 334 (1901); Small, *Flora South-eastern U.S.* 1322 (1903).
*Quercus coccinea*, var. *ambigua*, Asa Gray, *Manual*, 454 (1867).

Described by the younger Michaux as a large tree with the leaves of *Q. rubra* and the fruit of *Q. coccinea*. It was first seen by his father on the banks of the St. Lawrence near Quebec, and was found by himself in Maine, New Hampshire,

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[1] The figure is drawn from a wild specimen, and represents an extreme form of the leaf. Many wild specimens and most of the trees in cultivation have leaves more like *Q. rubra* in lobing.

Vermont, and Nova Scotia, where it was known as the grey oak. Britton and Small, who consider it to be a distinct species, extend the distribution to New York and Pennsylvania, and as far south as the mountains of North Carolina, and describe the leaves as like those of *Q. rubra*, seven- to thirteen-lobed to the middle or somewhat beyond. Sargent[1] refers to *Q. ambigua* as a form of *Q. rubra*, having fewer lobes to the leaves, and smaller fruits with turbinate cups; but states that these extreme forms are so intermixed and inconstant that it does not seem practicable to consider them even varieties. All this evidence goes to prove that this name covers a series of hybrids[2] between *Q. coccinea* and *Q. rubra*.

At Arley Castle, trees of typical *Q. rubra*, which freely bear fruit with large flat shallow saucer-like cupules, invariably have leaves turning dull reddish brown and falling off early in autumn. Other trees, with smaller acorn-cups, which though shallow are not quite flat at the base, but prolonged into a short scaly stalk, are deciduous late in the season, and their leaves turn a brilliant scarlet before falling. Such trees correspond to the description given of *Q. ambigua*, and are in all probability hybrids of *Q. rubra* and *Q. coccinea*.

*Q. coccinea* bears fruit only rarely in England; and we have seen no fruiting specimens of Waterer's *Q. coccinea splendens*, which turns a brilliant crimson in autumn; but this tree is probably true *Q. coccinea*.

In the absence of fruit, *Q. coccinea* is best distinguished by the buds, white-pubescent in their upper half; and by the leaves, shining beneath, more deeply lobed than in *Q. rubra*, falling late in the season, after turning a brilliant scarlet or crimson. Trees with the foliage of *Q. rubra*, dull beneath, but turning scarlet in autumn, and late in falling, may be assigned to *Q. ambigua*.

The scarlet oak is the most ornamental species in North America, on account of its deeply cut foliage, shining green in summer and brilliant scarlet in autumn. The leaves are retained late in the autumn, after most of the other oaks have withered and fallen.[3] It attains its northern limit in southern Ontario, and is widely distributed through the northern parts of the United States from south-eastern Nebraska eastward through central Minnesota and Michigan, southern New York, Vermont, and southern New Hampshire to the valley of the Androscoggin river in Maine. It is very abundant on the coast region from Massachusetts to New Jersey, where it is generally found on light dry usually sandy soil; but is less common in the interior, where it grows on dry gravelly uplands, and on the prairies of the west. It extends to northern Illinois and the District of Columbia, and along the Alleghany Mountains to North Carolina. It is occasionally planted in the north-eastern states in towns, but is said to be undesirable for streets, as young trees are disposed to be wide-spreading and unsymmetrical. Its timber is not distinguishable from that of the red oak in commerce, and is identical with it in appearance and quality.

(A. H.)

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[1] *Silva N. Amer.* viii. 127, note.

[2] Baenitz, in *Allg. bot. Zeitschr.*, 1903, p. 85. has, under the name *Q. Benderi*, described similar hybrids growing at Breslau.

[3] Cf. Hough, *Trees N. States and Canada*, 147 (1907).

### REMARKABLE TREES

The scarlet oak was introduced very early, as a plant is said to have been growing in Bishop Compton's garden in 1691. Loudon states that the largest tree which he had seen and knew with certainty to be this species, was at Syon, 77 ft. high and 2 ft. 9 in. in diameter in 1838. This tree is no longer living. He mentions a considerable number of other trees, of which he had received reports; but we believe that their identification was in many cases erroneous. The scarlet oak does not appear in England to grow so large or attain as great an age as *Q. rubra*; and we have seen only a few trees of considerable size.

The finest is perhaps a tree[1] at Arley Castle, 78 ft. high and 6 ft. 3 in. in girth in 1904. At West Dean Park, Chichester, there are four trees, 63 ft. by 3 ft. 8 in., 59 ft. by 3 ft. 6 in., 60 ft. by 4 ft. 8 in., and 48 ft. by 1 ft. 10 in., two of which bore fruit in 1909. These are considerably smaller than two specimens of *Q. rubra* which were probably planted at the same time, though the date is unknown.

At Stoke Park, Stoke Pogis, Bucks, there is a tree, which was still bearing foliage, scarlet in colour, on 18th November 1909, which Mr. E. H. Wilding reports to be 55 ft. high by 6 ft. 9 in. in girth. At Brocklesby, a tree measured 66 ft. by 3 ft. 9 in. in 1909. At Kew, a tree in the oak collection, about 25 ft. high, bore good fruit in 1907, but died in 1909. At Terling Place, Essex, there is a small tree, turning brilliant scarlet in autumn and about 25 ft. high, which was raised from acorns sent by Asa Gray in 1885. At Syon, there is a thriving young tree, about 30 ft. high, which bore acorns in 1907. This was pronounced by Prof. Sargent to be the best specimen which he had seen in England. At Ponfield, Herts, a small tree 35 ft. by 2 ft. 4 in., planted in 1883, bore fruit in 1909. At Tortworth and Westonbirt there are specimens of this species, none of which appear to have ever borne fruit. At Escot there is a tree rather crowded in a shrubbery, whose leaves, when I saw it on 27th October 1909, had mostly fallen, but which we believe to be of this species. It measures about 70 ft. by 6 ft.

There are probably other trees which we have not seen. But those which I have raised from American acorns, as well as those which I have imported as seedlings, will not grow on my soil; and I believe that it is better to graft scions selected from the best coloured trees on stocks of *Q. rubra*, than to plant this tree on its own roots. (H. J. E.)

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[1] This tree is No. 23 in Mr. Woodward's catalogue, and was probably planted about 1820. It has long borne the name *Q. palustris*. Fruit has not been noticed on this tree.

## QUERCUS PALUSTRIS, PIN OAK

*Quercus palustris*, Muenchhausen, *Hausv.* v. 253 (1770); Loudon, *Arb. et Frut. Brit.* iii. 1887 (1838); Sargent, *Silva N. Amer.* viii. 151, tt. 422, 423 (1895), and *Trees N. Amer.* 232 (1905).
*Quercus rubra dissecta*, Lamarck, *Dict.* i. 720 (1783).
*Quercus rubra ramosissima*, Marshall, *Arbust. Am.* 122 (1785).

A tree, attaining in America 120 ft. in height and 15 ft. in girth, but usually considerably smaller. Bark of young trees smooth, shining, light brown tinged with red; on old trunks about an inch thick and covered with small scales. Branches more or less pendulous, with drooping branchlets, which in the first year are slender, glabrous, shining, with white lenticels. Buds ovoid, about ⅛ in. long, pointed, with glabrous pale brown ciliate scales. Leaves (Plate 334, Fig. 17) deciduous, 4 to 6 in. long, 2 to 4 in. wide, obovate, cuneate at the base, divided about half-way to the midrib by rounded wide sinuses into usually seven, occasionally nine, symmetrical, bristle-pointed, oblong-triangular, entire or two- to three-toothed lobes; the terminal lobe acuminate, the lateral lobes spreading or directed forwards; shining above and below, glabrous except for conspicuous brown axil-tufts on the lower surface; petiole slender, glabrous, ½ to 2 in. long.

Fruit ripening in the second year, short-stalked, solitary or clustered; acorns hemispherical, ½ in. in diameter, enclosed at the base only by a thin saucer-shaped cupule, covered by thin closely appressed ovate minutely pubescent scales.

This species is readily distinguished, apart from the shape of the leaves with their characteristic conspicuous axil-tufts, by the drooping habit of the branches and branchlets.

The pin oak is found on deep rich soil on the borders of swamps and in alluvial land, in company with *Liquidambar*, *Nyssa sylvatica*, *Acer rubrum*, *Populus heterophylla*, and hornbeam, but thrives well when transplanted to drier situations. It is widely distributed in the United States from Massachusetts southwards to Virginia, and westwards through Kentucky, Tennessee, and northern Arkansas to the eastern borders of Indian Territory, Missouri, and Illinois, attaining its largest size on the banks of streams in the basin of the lower Ohio. It is also very common on the coast plain south of the Hudson river, but is rare and of small size in New England. (A. H.)

### CULTIVATION

Though introduced on the Continent prior to 1770, this species does not seem to have been known in England until 1800, when it was introduced[1] by Messrs. Fraser. It is one of the most beautiful American oaks, on account of the varied colour of its leaves both in spring and autumn. As a rule it grows better in England than any American oak except perhaps *Q. rubra*, and seems to prefer a deep sandy soil, and a position well sheltered from wind by other trees. As a rule it is easily recognised by the number of small, rather pendulous branches, which it throws out among the larger ones, and by its upright habit. It grows fast on good soil, and Loudon says that in Loddiges' nursery in 1837 he saw some which at seven years from the acorn were 15 ft. high. It rarely ripens fruit in England, but I raised some plants from acorns grown at Kew in 1901, which I believe to be of this species, and which are growing well at Colesborne.

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[1] Aiton, *Hort. Kew.* v. 292 (1813).

The largest trees that we know of are in Windsor Park, near China Island, one of which in 1910 was 97 ft. by 10 ft. 11 in. (Plate 315). Not far off, there is another tree that has been carefully measured by Mr. Squires, who finds it to be 113 ft. by 10½ ft. Another in the Rhododendron Drive was 100 ft. by 7 ft. 8 in. in 1909. At Kew there is a tree at the south end of the Temperate House, which has had its top broken some years ago, and now measures 57 ft. by 10 ft. At Arley Castle there are two trees, of which the finest (No. 189 in Mr. Woodward's catalogue) was 80 ft. by 6 ft. 4 in. in 1905. One at Bayfordbury, planted in 1840, was 71 ft. by 6 ft. 8 in. in the same year.

At Canford Manor there is a very fine tree 80 ft. by 8 ft. in 1906; at Oakly Park, Ludlow, another, 75 ft. by 8 ft. in 1908; at Milford House, Godalming, a well-shaped tree 84 ft. by 7 ft. 9 in. in 1909; and at Deepdene, Surrey, Henry measured a tree, which was perfectly sound, 70 ft. by 9 ft. 10 in. in 1905.

In Scotland and Ireland we know of no trees of any size. (H. J. E.)

## QUERCUS SCHNECKII

*Quercus Schneckii*, Britton, *Manual*, 333 (1901).

*Quercus texana*, Sargent, *Garden and Forest*, vii. 514, ff. 81, 82 (1894), *Silva N. Amer.* viii. 129, t. 411 (1895), and *Trees N. Amer.* 235 (1905) (not Buckley).[1]

A tree, the tallest[2] of the American oaks, attaining 180 ft. in height, and 8 ft. in diameter above the much enlarged and buttressed base. It is with difficulty distinguishable in the absence of fruit from *Q. palustris*, though the leaves[3] (Plate 334, Fig. 15) are broader in proportion to their length than in that species, but have the same conspicuous axil-tufts, while the buds and branchlets are identical.

Fruit, ripening in the second year, stalked; acorn ovoid, about an inch long, pubescent; cupule hemispherical, ¾ in. in diameter, covered with closely appressed tomentose scales.

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[1] According to Small, *Q. texana*, Buckley, in *Proc. Phil. Acad.*, 1860, p. 444, is a small tree or shrub, occurring in dry and rocky places in Texas, and distinct from *Q. texana*, Sargent, which is now correctly named *Q. Schneckii*, Britton.

[2] Ridgway says in *Proc. U.S. Nat. Mus.* p. 83, that in the bottoms of southern Illinois, trees straight as an arrow 5 or even 6 ft. in diameter above the spurs, and 50 to more than 70 ft. clear, were formerly not at all rare, but most of them had even then been cut for clapboards or barrel staves. The largest that he had measured was 23 ft. in girth round the top of the stump, with a trunk 76 ft. long and 3 ft. in diameter at the top. At 120 ft. from the ground the limbs were more than a foot in thickness. Assuming the taper of this tree to have been regular, the log would have contained about 1200 cubic ft. by quarter girth measure. Ridgway speaks of these trees as *Q. rubra*; but Sargent considers them to be his *Q. texana*, referred now to *Q. Schneckii*.—(H. J. E.)

[3] Figured by us from excellent fruiting specimens, collected by Elwes on Mt. Carmel, Illinois.

This species is widely spread, in wet swampy land, along the borders of streams in the Mississippi basin.

A small tree at Kew, about 12 ft. high, raised from seed sent by Meehan in 1901, under the name *Q. texana*, may be *Q. Schneckii*; but this species, inhabiting a region which is very hot in summer, is not likely to succeed in England.

(A. H.)

## QUERCUS AGRIFOLIA, Californian Live Oak

*Quercus agrifolia*, Née, in *Ann. Cienc. Nat.* iii. 271 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1894 (1838); Sargent, *Silva N. Amer.* viii. 111, t. 403 (1895), and *Trees N. Amer.* 256 (1905).
*Quercus oxyadenia*, Torrey, *Sitgreave's Report*, 172, t. 17 (1853).
*Quercus berberidifolia*, Liebmann, in *Overs. Dansk. Vidensk. Selsk. Forhandl.* 172 (1854).
*Quercus acroglandis*, Kellogg, in *Proc. Cal. Acad.* i. 23 (1855).

A large tree, or occasionally a shrub, in California. Bark of young trees thin, smooth; on old trunks 2 to 3 in. thick, and divided into broad scaly ridges. Young branchlets, with a dense stellate pubescence, either quickly deciduous, or retained till the second year. Leaves (Plate 338, Fig. 57) persistent for two years, coriaceous, 1½ to 2 in. long, about 1½ in. broad, ovate or orbicular, acute or rounded at the apex, rounded or slightly cordate at the base; with seven to thirteen spine-tipped teeth, variable in size; lateral nerves very prominent, four or five pairs, reaching the margin; upper surface dark green, shining, glabrescent or with scattered minute pubescence; lower surface glabrous, with conspicuous reddish brown axil-tufts of pubescence; petiole ¼ to ½ in. long, stellate-pubescent.

Fruit, ripening in the first year, sessile or sub-sessile, solitary or in pairs; acorn elongated, and gradually narrowing to an acute apex, about an inch long, surrounded at the base by a turbinate cupule, about ½ in. broad, silky pubescent within, and covered with thin glabrous ciliate scales.

This species is readily distinguished from all the other oaks with holly-like foliage, by the conspicuous axil-tufts on the leaves beneath. (A. H.)

In California this is a common oak, extending from Mendocino County southwards to Lower California, less common in the north, very abundant and attaining its greatest dimensions in the valleys south of San Francisco, where it is the largest and most generally distributed oak on the foot-hills between the mountains and the sea. On the coast it often covers the sandy dunes with its semi-prostrate and contorted stems, and in a bushy form ascends the dry slopes in the San Gorgonio pass to about 2800 ft.

Sargent describes it as a low round-topped tree, sometimes attaining 80 to 90 ft. high, with a thick short trunk from 3 to 6 ft. in diameter, which often divides into great spreading limbs resting on the ground, and covering an area 120 to 150 ft. in diameter.

Excepting for fuel the timber is little used, though in the narrative of Vancouver's voyage it is related that some knees were cut in 1793 from the holly-leaved oak at Santa Barbara to repair his ship the *Discovery*. The Indians used to consume the acorns for food, preferring them to those of any other oak.

This species was introduced by Hartweg in 1849, when a few miserable living plants, sent home by him, were reported[1] to be growing in the Horticultural Society's Garden at Chiswick. As I can find no further allusion to this species, I suppose that these are the trees which we have found growing in two places in England, and which seem of similar age, namely, at Kew, where it has now attained a height of 30 ft.; and at Killerton, where there are two trees above the house close to the deer-park fence. In 1908 the best of these measured 45 ft. by 7 ft., and forks at 6 ft. from the ground. On April 18, it was budding, and the old leaves were still green. At Tortworth there is a small tree which seems to be younger, and was probably raised in 1878 from American acorns at the same time as *Q. Kelloggii*.

(H. J. E.)

## QUERCUS WISLIZENI

*Quercus Wislizeni*, A. de Candolle, *Prod.* xvi. 2, p. 67 (1864); Sargent, *Silva N. Amer.* viii. 119, t. 406 (1895), and *Trees N. Amer.* 253 (1905).

*Quercus parvula*, Greene, *Pittonia*, i. 40 (1887).

A tree or shrub, similar to *Q. agrifolia* in habit, size, and bark. Young branchlets with scattered stellate pubescence. Leaves (Plate 338, Fig. 58) deciduous in the second year, variable in shape and size, mostly oblong-lanceolate, averaging 1½ in. long and ⅝ in. wide, coriaceous, acute at the apex, broad and rounded or truncate at the base, with 9 to 13 spine-tipped teeth in the wrinkled margin, which in rare cases is entire; both surfaces shining, glabrous, with a conspicuous network of fine veinlets; petiole ⅛ in. long, stellate-pubescent.

Fruit ripening in the second year, sessile or stalked; acorns ovoid, about 1 in. long, acute at the apex, enclosed to a variable height in a turbinate or tubular cupule, slightly pubescent within, and covered by thin lanceolate pubescent scales.

This species, in the absence of fruit, is with difficulty distinguishable from *Q. coccifera*, which has, however, foliage of a lighter tint of green. The buds in *Q. Wislizeni* are long, spindle-shaped, and pointed at the apex; while those of *Q. coccifera* are smaller, ovoid, and obtuse.

*Q. Wislizeni*, which is closely related to *Q. agrifolia*, is widely spread throughout California, and is also found on the San Pedro Martir mountain in Lower California. It is most abundant and of its largest size in the valleys of the coast range of central California and on the foothills of the Sierra Nevada. It is common in a shrubby form in the cañons of the desert slopes of the mountains in the southern part of the state.

Introduced into Kew by Mr. H. N. Bolander, who sent acorns in 1874, it was only 6½ ft. high in 1897, but of late years is more thriving, and now forms a bushy tree about 15 ft. in height. We have seen no specimens in cultivation elsewhere.

(A. H.)

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[1] *Journ. Hort. Soc.* vi. 158 (1851). A figure is given, showing the long narrow pointed acorns.

## QUERCUS CRASSIPES

*Quercus crassipes*, Humboldt and Bonpland, *Pl. Æquin.* ii. 37, t. 83 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1943 (1838); De Candolle, *Prod.* xvi. 2, p. 73 (1864); Hemsley, *Biol. Cent. Amer. Bot.* iii. 170 (1882).

*Quercus mexicana*, Bentham, *Pl. Hartw.* 56 (1839) (not Humboldt and Bonpland).

A tree of moderate size. Young branchlets slender, covered with a dense minute pubescence. Buds minute, globose. Leaves (Plate 335, Fig. 24) coriaceous, persistent for two years, 2 to 3 in. long, ½ to ¾ in. wide; oblong; rounded or acute at the apex, which usually bears a short mucro or bristle; rounded or subcordate at the base; entire or rarely undulate in margin; upper surface dark green, papillose, glabrescent; lower surface grey or brownish tomentose; lateral nerves about 20 pairs, dividing and looping before reaching the margin; petiole ⅛ to ¼ in. long, densely pubescent.

Fruit ripening in the second year, solitary or in pairs, on short stout stalks; acorn ovoid, surrounded about half its length by a turbinate cupule, ½ to ¾ in. in diameter, covered with appressed slightly pubescent ovate scales.

This species was discovered by Humboldt near Santa Rosa and Ario in southern Mexico, at 6000 to 8000 ft. elevation, and was said to be a small tree about 20 ft. high, with smoothish grey bark. It was also collected by Hartweg at Tlalpujahua, and found by Bourgeau in the valley of Mexico.

It was raised[1] in 1839 in the Chiswick Garden of the Horticultural Society from acorns collected by Hartweg near Real del Monte.

The only specimen which we know to be now living in this country, is an unhealthy tree at Carclew, 64 ft. by 5 ft. 4 in. in 1908. A small tree of this species is cultivated in M. Allard's arboretum at Angers, where it is labelled *Q. crassifolia.* A specimen in the Kew Herbarium, collected by Gay at Leroy's nursery, Angers, in 1847, is labelled *Q. confertifolia.* (A. H.)

## QUERCUS CERRIS, Turkey Oak

*Quercus Cerris*, Linnæus, *Sp. Pl.* 997 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1846 (1838); Willkomm, *Forstliche Flora*, 421 (1887); Mathieu, *Flore Forestière*, 363 (1897).

*Quercus crinita*, Lamarck, *Encyc.* i. 718 (1783).

*Quercus echinata*, Salisbury, *Prod.* 393 (1796).

A tree attaining 120 ft. in height and 20 ft. in girth. Bark thick, greyish, divided by vertical and horizontal fissures into oblong rounded ridges. Young branchlets covered with a dense grey tomentum, retained in part in the second year. Buds (Plate 78, Fig. 3) ovoid, with a few pubescent ovate-acuminate scales, and surrounded by a whorl of long linear-subulate tomentose stipules. Leaves (Plate 335, Fig. 22) coriaceous, deciduous in autumn, 5 to 6 in. long, 2 to 3 in. broad, oblong to oval, acute at the apex, cuneate or rounded and unequal at the base; variously lobed, with deep or shallow sinuses; lobes, seven or eight pairs, unequal in length, oblong or triangular, entire or with one or two teeth, acute at the apex, which is cartilaginous, without a clearly projecting mucro; upper surface dark green, with numerous minute stellate hairs; lower surface greyish or dark green, covered with a minute stellate pubescence; midrib and nerves reddish with more conspicuous longer pubescence; petiole ½ to ¾ in. long, tomentose.

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[1] Cf. Gordon, in Loudon, *Gard. Mag.* xvi. 636 (1840).

Staminate catkins tomentose, 2 to 3 in. long; calyx tomentose, stamens four. Pistillate flowers, one to four on a short stout tomentose peduncle, only one as a rule developing; stigmas four, reflexed, sessile.

Fruit ripe in the second autumn, one to four on the branchlet of the preceding season, which may or may not have developed a leafy branch of the second year; each solitary on a short stout tomentose stalk; acorn variable in length, averaging one inch, depressed and slightly pubescent at the apex, glabrous elsewhere; cupule hemispherical, ½ to ¾ in. in diameter, densely covered with long linear grey tomentose scales, all reflexed and curved or hooked, except those in the upper zone, which are erect and inflexed, forming a loose fringe around the margin of the cupule, closely surrounding the acorn.

## Varieties and Hybrids

In the wild state there is considerable variation in the shape of the leaf.

1. Var. *austriaca*, Loudon. *Quercus austriaca*, Willdenow, *Sp. Pl.* iv. 454 (1805).

Leaves with regular triangular entire lobes, greyer beneath than in the typical form. This variety is prevalent in south-eastern Europe.

2. Var. *pseudocerris*, Boissier, *Flora Orient.* iv. 1171 (1879).

Leaves deeply divided into linear, entire or three- to five-lobulate segments. This variety occurs occasionally in Greece and Asia Minor.

Several forms have arisen as sports in the seed-bed.

3. Var. *laciniata*, Petzold and Kirchner, *Arb. Musc.* 636 (1864).

Leaves deeply and irregularly lobed, the sinuses extending to near the midrib, some of the leaves only ½ in. wide.

4. Var. *variegata*, Loddiges, *ex* Loudon.

Leaves variegated with white blotches. This is said[1] to have originated as a sport at Woburn Abbey, where good specimens of it are now growing.

5. Var. *pendula*, Neill, *ex* Gilpin, *Forest Scenery*, i. 73 (1834).

Branches pendulous. Loudon mentions a remarkable weeping tree at Hackwood Park. This variety[2] does not seem to be propagated at the present time.

The hybrids are described under *Q. Lucombeana*, p. 1259.

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[1] *Gard. Chron.*, 1873, p. 1046.

[2] It is mentioned as well known in *Gard. Chron.*, 1871, p. 1321.

## DISTRIBUTION

The Turkey oak is a native of southern Europe, Asia Minor, and northern Syria. It occurs in central and northern Spain. In Italy it grows in the Apennines mixed with the common oak, occasionally descending into the region of the olive and ascending into that of the beech, reaching its most southerly points in Calabria and Sicily. In France it is a rare and doubtfully wild tree in the Jura, in Vienne, Brittany, Anjou, and in Provence near Grasse; but in the department of Doubs it is very abundant in some of the oak forests, notably that of St. Vit, where it is the dominant tree over an area of 250 acres. It is unknown in the Swiss and French Alps, and in the Tyrol; but is scattered as an isolated and rare tree throughout Croatia, Dalmatia, Istria, Carniola, Styria, and Austria, reaching its northern limit at St. Pölten, west of Vienna, and the Polauer mountain in Moravia.

It becomes much more abundant in Hungary, where it is common in the hilly land and on mountain slopes, extending eastward through Banat to Transylvania. It is perhaps the commonest broad-leaved tree in many parts of the Balkan states, where it either forms pure woods at the higher elevations, or occurs on the lower hills in mixture with *Q. conferta* and *Q. sessiliflora*. In these regions its wood is never exported, and is little used except for firewood. (A. H.)

## CULTIVATION

It is uncertain when this tree was first introduced, for though mentioned by Evelyn, it seems doubtful whether he really knew the tree, as he says, "we shall say little of the *Cerris* or *Ægilops*, goodly to look on, but for little else." In Miller's[1] time, however, about 1740, it was in cultivation; and in the latter half of the eighteenth century was largely planted in the south and south-west of England.

Though it is perfectly hardy, and according to Mouillefert,[2] endured at Grignon in the winter of 1879-80 a temperature of −26° Cent., which injured many of the common oaks, it only attains its best dimensions in the warmer parts of England on deep and fertile soils. It endures lime, but prefers a warm sandy soil. It has a long tap root with few fibres, and, as Loudon remarks, is therefore not easy to transplant. When sown in the open the young immature shoots are often injured by frost, and require some protection during the first winter.

This tree grows faster than the common oak on dry sandy soils, and in consequence has been planted in the southern counties more commonly than it deserves to be; for though it is a handsome ornamental tree, yet its timber is so inferior to that of the pedunculate and sessile oaks that it has little market value, as many landowners have found to their loss when the tree is felled. It ripens seed freely in most seasons, and the seedlings, though not so hardy as those of the common oak, come up freely on sandy soils, and in a few years shoot up rapidly. Loudon says that near London the length of the annual shoot is from 18 in. to 3 or 4 ft., and that at Knedlington in Yorkshire plants of only seven years from seed were 12 ft. high. At Colesborne, however, the growth is very much slower than this, the soil and climate being too poor and cold for this species, which rarely attains any great size in the northern counties. It transplants perhaps better in spring than in autumn, and ripens its wood late, the leaves usually lasting longer than those of the common oak. Its trunk has a tendency to grow straight, and the branches have a peculiarity never seen in common oaks, of thickening close to the trunk. This is shown conspicuously in all the old specimens of the original Lucombe oak, and convince me that its parent was a *Q. Cerris.* It sometimes grows very tall without forming many branches; a young tree standing alone in a grass field at Cuffnells was 80 ft. high, with a girth of only 5 ft.

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[1] Miller mentions a large tree growing at Ragnal, near Tuxford, Nottinghamshire, which was supposed by Loudon to be a form of the Turkey oak.

[2] *Essences Forestières*, 93 (1903).

### REMARKABLE TREES

The largest Turkey oaks that we have seen or heard of are at Mamhead Park near Exeter, which seems to have exactly the soil and climate best suited not only for this species, but also for the Ilex and cork oaks. Here there are several trees, of which one is the tallest recorded anywhere, and measures at least 120 ft. high, with a trunk almost free from branches to about 50 ft. and 13 ft. 8 in. in girth in 1908. It grows at an elevation of 500 to 600 ft. in a sheltered ravine facing east above the house, and is well protected by other tall trees (Plate 317). Another tree remarkable for its immense spread, is on the north side of the entrance-drive below the house, and is about 85 ft. high, with a short bole 18 ft. 9 in. in girth, spreading at the ground, where it measures over 40 ft. round (Plate 318). The total circumference of the branches was no less than 140 paces in 1908, being in this respect only surpassed in England by a wonderful Cedar of Lebanon at Langley Park Bucks, the seat of Sir R. Harvey, which I had not seen when Vol. III. was published, and which measures 146 paces round the branches. Besides these grand trees there are two more in the park below the house, one of which is about 115 ft. by 13 ft., with a clean bole 40 ft. long, and the other about 105 ft. by 18 ft. 4 in. Three of these trees are mentioned by Loudon (p. 1861) as having been planted by Lucombe, who is said to have been gardener at Mamhead, and this may have been about 1760, as he raised the original Lucombe oak about 1765; and I could find none of the latter now at Mamhead. Their dimensions are given by Loudon as 100 ft. by 12 ft., 90 ft. by 15 ft., and 80 ft. by 14 ft. 1 in. All of them are still in good health, and show no signs of decay in the branches.

Another very fine tree, though its habit is not at all typical of its kind, is in the deer park at Belton (Plate 316). It measures about 100 ft. high by 18½ ft. in girth, with a short bole of about 12 ft., which in 1905 was attacked by fungus (*Polyporus*), and will, I fear, decay. It is growing on a red sandy loam.

Another is a fine tree at Gatton Park, which measures 108 ft. by 12 ft. 8 in., with a bole of about 20 ft. Nearly as tall and even better in its habit, is one at Leeds Castle, Kent, which in 1902 I found to be 105 ft. by 11½ ft., with a clean straight stem over 50 ft. long. At Badminton Park there is a tree about 100 ft. by 10 ft. 4 in. which is known as the "Raglan Oak." At Bayfordbury, a well-shaped tree measures 96 ft. by 11 ft.

At Corsham Court there is a tree with very drooping branches which spread on the grass, and measure 78 paces round. Miss Woolward tells me of a very fine tree at Boughton Malherbe Rectory near Maidstone, which in 1908 was 85 ft. by 17½ ft., and has a spread of 100 ft. At Stratton Park and at Hackwood Park in Hants there are very large Turkey oaks which I have not measured. In the north of England the best I know is a tree in Ray wood at Castle Howard, which has been drawn up by surrounding beeches to a height of 98 ft., with a bole 40 ft. long, girthing 10½ ft.

In Wales by far the largest I have seen is at Dynevor Park, which was carefully measured in 1906 by the Hon. W. Rice, who made it 103 ft. by 14 ft. 7 in., with a spread of 103 ft.

In Scotland the Turkey oak is seldom seen. The largest mentioned by Loudon were at Hopetoun House, 50 ft. by 6 ft. 9 in., and at Brahan Castle, 50 ft. by 6 ft. The last tree may probably be the same as one which I measured in the dell below that beautiful place, and which, in July 1907, was no less than 90 ft. by 10 ft. 4 in., by far the finest of its sort that I have seen in Scotland. At Bruach burn, near Beaufort Castle in the same county, a large Turkey oak is growing in a sheltered situation, which has a short bole 11 ft. 9 in. in girth, and a wide-spreading top.

## Timber

The timber of this tree has a bad reputation in the trade in England, because it will not stand weather, or alternations of wet and dry, like the common oak; and is therefore useless for outside work. Laslett, who was sent to Asia Minor in 1859 to search for oak suitable for the navy, says that in the valleys near Brussa *Q. Cerris* was found, and that this and the common oak were used by the Turks for naval shipbuilding, but he goes into no details. I have been told by boatbuilders in Cornwall that it is excellent for keels; but whatever may have been its value in French shipbuilding formerly, as stated by Bosc and others, it is now, according to Mouillefert, little used in France except for firewood.

Atkinson states[1] that the doors of the principal rooms in the Marquess of Downshire's house at East Hampstead, near Wokingham, were made of the wood of Turkey oaks cut down there about 1828, and that the wood is finer in the grain and takes a better polish than British or foreign wainscot oak, and is more beautiful than any oak he had seen. But the Marquess of Downshire informs me that as the present mansion was built about 1857 it is doubtful whether they still exist.

(H. J. E.)

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[1] *Trans. Hort. Soc. Lond.* i. 338 (1835).

## QUERCUS LUCOMBEANA, Lucombe Oak

*Quercus Lucombeana*,[1] Sweet, *Hort. Brit.* 370 (1827).
*Quercus Cerris*, Linnæus, var. *Lucombeana*, Loudon, *Arb. et Frut. Brit.* iii. 1851 (1838).
*Quercus exoniensis*, Loddiges, *ex* Loudon, *loc. cit.*
*Quercus hispanica*, var. *β*, *chêne à feuilles d'Ægilops*, Lamarck, *Encyc.* i. 723 (1783).
*Quercus ægylopifolia*, Persoon, *Syn.* ii. 570 (1807).
*Quercus Pseudosuber*, var. *ægylopifolia*, De Candolle, *Prod.* xvi. 2, p. 44 (1864).

The original Lucombe oak, in habit, vigour of growth, and branchlets, is similar to *Q. Cerris*; but differs in foliage, stipules, and fruit.

Leaves (Plate 335, Fig. 23) smaller than in *Q. Cerris*, never exceeding 5 in. long and 2 in. broad, usually smaller, subevergreen, falling early in the following year, usually in January and February, mostly[2] oblong ovate, acuminate at the apex, unequal at the base; with about seven pairs of regular triangular entire large teeth, each of which ends in a projecting mucro; lower surface covered with a dense whitish tomentum, different from the green or greyish under surface of *Q. Cerris*. The stipules around the lateral buds are shorter, and fall earlier than in *Q. Cerris*.

Fruit ripening in the second year; cupule turbinate, smaller in diameter than, and not hemispherical as in *Q. Cerris*, with grey tomentose scales shorter and broader than in that species, both reflexed and erect irregularly, not showing the definite arrangement of *Q. Cerris*, in which the upper marginal fringe of erect loose scales is clearly separated from the regularly reflexed scales of the rest of the cupule; acorn not depressed at the apex.

The original Lucombe oak was first described by Holwell in a letter[3] dated Exeter, February 24, 1772, which states that "About seven years past," *i.e.* about 1765, "Mr. Lucombe sowed a parcel of acorns saved from a tree of his own growth of the iron or wainscot species; when they came up, he observed one amongst them that kept its leaves throughout the winter. Struck with the phenomenon, he cherished and paid particular attention to it, and propagated by grafting some thousands from it."

Holwell's account is repeated, with some additions, in the *Gentleman's Magazine*, 1773, p. 446, where William Lucombe is described as "an ingenious gardener in the environs of Exeter." There is no doubt that the iron or wainscot oak is a local name in south Devon and Cornwall for *Q. Cerris*, and that Lucombe was at this time owner of the garden, which afterwards developed into the famous nursery at Exeter.[4] The Lucombe oak is said[5] to have been common in 1773 about St. Thomas's, a suburb of Exeter, and to have been cultivated with great success by the neighbouring farmers.

Holwell's account is substantiated by Loudon, who was informed by Mr. Pince in 1838 that it was raised about seventy-five years previously (*i.e.* in 1763, a trifling discrepancy in the date) by "Lucombe, who was founder of the Exeter Nursery, from seed gathered by him off a specimen tree of *Q. Cerris* which grew in his nursery, near to one of *Q. Suber*."

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[1] Sweet used this name for the first time. Holwell, who is often credited with it, gives no scientific name, and simply speaks of the tree as the Lucombe oak.

[2] All specimens show some irregularly lobed leaves, which also appear in all the descendants of this tree. The leaves are described above from the tree at Carclew.

[3] Published in *Phil. Trans.* lxii. 128 (1772).

[4] According to the heading of a bill of Lucombe, Pince, and Company, preserved at Kew, the nursery was founded in 1720.

[5] *Gentleman's Magazine*, xliii. 357 (1773)

The additional fact in Pince's account, which was derived from the younger Lucombe, who perfectly recollected the raising of the Lucombe oak in his father's nursery, is the existence of a cork oak, which must have pollinated one of the flowers of the parent Turkey oak. The botanical characters of *Q. Lucombeana*, which are partly those of *Q. Cerris* and partly those of *Q. Suber*, are thus satisfactorily accounted for; and, as is often the case in first crosses, the original Lucombe oak is remarkable for its vigour of growth.

From Hargham, in Norfolk, Sir Hugh Beevor sends us specimens of a natural seedling, about twenty-four years old, which originated in a similar manner from the acorn of a *Q. Cerris*, situated about 40 yds. to the westward of a *Q. Suber*. This tree, which is taller than a pure *Q. Cerris* of the same age beside it, has not yet borne acorns, but it resembles *Q. Lucombeana* in foliage. The leaves are similar in shape, having acute, triangular, strongly mucronate teeth; but it is only of late that their under surface has begun to develop the dense white tomentum that is so characteristic of the mature Lucombe oak.

The Lucombe oak was always propagated at the Exeter Nursery by grafting it upon *Q. Cerris*. The original tree was cut down when it was about twenty years old; but a grafted tree in the Exeter Nursery, planted in 1802, had attained 50 ft. in height and 8½ ft. in girth in 1837, and is figured[1] by Loudon, who mentions older trees[2] at Killerton and Carclew, the former eighty years old, and the latter seventy years old in 1834.

## SEEDLINGS OF THE LUCOMBE OAK

The original Lucombe oak, and the trees propagated from it by grafts, must be carefully distinguished from its seedlings, the history of which was clearly given to Loudon by Pince. These were raised by the younger Lucombe from acorns gathered from one of the grafted Lucombe oaks in 1792. As usually is the case, when the seed of a first cross is sown, a great number of varieties resulted, of which three were selected and propagated in the Exeter Nursery by grafting on *Q. Cerris*. Two other seedlings were reared at a later period, about 1830. None of these varieties appear to have been as vigorous[3] as the parent, and all had very corky bark, and kept their leaves till late in the season. These varieties all agree with the parent in the character of the branchlets and the mucronate points on the teeth or

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[1] *Arb. et Frut. Brit.* iii. figs. 1712, 1713. The measurement given under fig. 1712 is erroneous; it is correctly stated on p. 1855, where Loudon quotes a letter from Pince, dated 4th April 1837, describing the tree.

[2] The ages are given in round numbers, and are not strictly accurate, as none of the trees can be so old as 1763 or 1765, the dates given by Holwell and Pince for the original tree.

[3] The comparative rate of growth is shown by the following measurements of the trees in the Exeter Nursery, which were taken in 1837—

| | Years old. | Height in feet. | Girth in feet. |
|---|---|---|---|
| Original—grafted Lucombe | 35 | 50 | 8½ |
| Seedling—var. *crispa* | 45 | 63 | 9 |
| ,, var. *suberosa* | 45 | 45 | 7½ |
| ,, var. *incisa* | 45 | 45 | 7 |

lobes of the leaves, but differ in the shape of the leaves and in the characters of the fruit. The five seedlings, raised in the Exeter Nursery, were named by Loudon :—

1. Var. *suberosa*, Loudon. Smaller trees, with very corky bark, raised in 1792. Stipules short and quickly deciduous. Leaves (Plate 339, Fig. 64) smaller than in the original Lucombe oak, 2 to 2½ in. long, 1 in. broad; ovate; broad, rounded, and unequal at the base; acute at the apex, white tomentose beneath, usually with five to seven pairs of rounded or sinuate sharply mucronate teeth; some of the leaves, however, with fewer teeth, and one to three deep sinuses extending half-way to the midrib. Fruit ripening in the second year; cupule turbinate, with short broad grey tomentose scales, reddish at the tips, mostly erect.

2. Var. *heterophylla*, Loudon. Raised about 1830. Leaves oblong-lanceolate, 3 to 4 in. long, 1 to 1½ in. broad, acute at the apex, irregularly and deeply lobed, with the middle part of the leaf occasionally reduced to a narrow fringe on each side of the midrib. Cupules of the fruit turbinate; most of the scales short, ovate, ending in red acuminate tips; a few towards the margin of the cupule, linear-lanceolate, irregularly erect, and reflexed.

3. Var. *crispa*, Loudon, who calls it the new Lucombe oak. This was raised in 1792, and has very corky bark. Leaves subevergreen, falling in March and April, similar to those of *Q. Lucombeana*, but smaller in size and wrinkled in margin, 2 to 3 in. long, oblong-ovate, acute at the apex, unequal at the base, with six to eight pairs of acute triangular mucronate teeth; densely white tomentose beneath. Cupule scales reddish at the tips; those towards the margin long and directed upwards; those below short, some appressed, others reflexed. Acorn scarcely depressed at the apex, which is tipped with a short conical tomentose umbo.

4, 5. Var. *incisa* and var. *dentata*, Loudon, with large leaves, more deeply lobed than those of the preceding forms, are scarcely distinguishable from the original Lucombe oak, except in having more corky bark. Var. *incisa* was raised in 1792, and var. *dentata* about 1830. *Q. Cerris*, var. *cana major*, Loudon, *op. cit.* 1849, the origin of which is unknown, is very similar to these varieties.

In addition to the original Lucombe oak and its selected seedlings there remain a few forms the history of which is unknown, but which have undoubtedly arisen from the same parentage of *Q. Cerris* and *Q. Suber*. It is most convenient to name these as vars. of *Q. Lucombeana*.

6. Var. *fulhamensis*.

*Quercus Cerris*, var. *fulhamensis*, Loudon, *Arb. et Frut. Brit.* iii. 1850 (1838).
*Quercus Cerris*, var. *dentata*, Watson, *Dend. Brit.* ii. t. 93 (1825).
*Quercus hispanica*, α, *chêne de Gibraltar*, Lamarck,[1] *Encyc.* i. 723 (1783).
*Quercus Pseudosuber*, var. *gibraltarica*, De Candolle, *Prod.* xvi. 2, p. 44 (1864).

Trees with less vigorous branches than *Q. Lucombeana*, forming a rounded head of foliage; bark moderately corky. Branchlets grey tomentose. Stipules around the axillary buds short and early deciduous. Leaves (Plate 335, Fig. 21) usually deciduous in January and February, ovate, broader in proportion to their length, and smaller than those of *Q. Lucombeana*, about 3 in. long and 1½ in. wide; broad, rounded, and unequal, or occasionally auricled at the base; acute at the apex; with 5 to 8 pairs of sinuate mucronate teeth; white tomentose beneath.

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[1] Lamarck applied the name *Q. hispanica* not to a Spanish oak, but to three trees cultivated at the Trianon, which were specimens of the Lucombe, Fulham, and Turner's oaks. The first of these was erroneously supposed to grow wild in the neighbourhood of Gibraltar.

Fruit ripening in the second year; cupule hemispheric, smaller than in *Q. Cerris*, with lanceolate acuminate grey tomentose scales, red at the tips, usually all reflexed, except a few erect and curving inwards at the margin of the cupule, but not forming a regular fringe as in the Turkey oak; acorn not depressed at the summit, which bears a stout short tomentose umbo.

The original Fulham oak grew in Whitley and Osborne's nursery at Fulham, and was,[1] in 1835, 75 ft. high and 11½ ft. in girth. Loudon supposed it to be a seedling; but in 1840 it sent forth a branch from the base, which proved it to have been grafted on *Q. pedunculata*.[2] It appears to have been always reproduced in the Fulham Nursery by grafting on the common oak. The origin of this tree is unknown; but an oak of apparently the same age, which was 80 ft. high and 4½ ft. in diameter at a foot from the ground in 1835, is said by Pince[3] to have been planted by Lucombe at Mamhead. This tree cannot now be identified, if it still exists. We can only conjecture that the Fulham oak, like a large *Q. Lucombeana* which grew beside it in the Fulham Nursery, was procured from Lucombe. Different in foliage and in fruit from the original Lucombe oak, it is possibly one of its earliest seedlings, of which no record was kept.

There are two trees, which we believe to be of this origin, at Kew, growing near the No. 3 Museum; one (Plate 319) measures 69 ft. by 7½ ft.; the other, 63 ft. by 7 ft. 1 in.

7. Var. *fulhamensis latifolia.*

The original Fulham oak produced acorns freely from which many plants were raised, differing greatly in appearance from one another, and from the parent. About 1838, Messrs. Osborne selected a seedling with leaves broader and less dentate than usual, which they propagated under the name *Q. fulhamensis latifolia*. Specimens[4] corresponding to this description from Westonbirt, Abbotsbury, and Liphook differ from all the other oaks of this series, in having leaves rounded and not acute at the apex, elliptical, about 3½ in. long, and 2½ in. broad, grey tomentose beneath, with 7 or 8 pairs of lateral nerves, each ending in the mucronate apex of a broad shallow sinuate tooth. Fruit not seen.

8. Var. *diversifolia.*

*Quercus Ilex*, var. *diversifolia*, Nicholson, in *Kew Handlist of Trees*, 189 (1896).

A small tree, with remarkably ascending branches, and thick corky bark.

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[1] Loudon, *Gard. Mag.* xi. 128 (1835). Watson, *Dend. Brit.* ii. t. 93 (1825), gives its measurements in 1825 as bole 10 ft., total height 60 ft., diameter 2 ft. 3 ins.

[2] W. K., in *Gard. Chron.*, 1842, p. 111. There are also specimens at Kew of the original Fulham oak, collected by Nicholson in 1881, which show a branch of *Q. pedunculata*, found growing from the stock.

[3] In Loudon, *Gard. Mag.* xi. 128 (1835).

[4] A small tree outside the garden at Mamhead has foliage very similar, only differing in being somewhat narrower, but with identical nervation and shallow teeth.

Branchlets grey tomentose; stipules early deciduous. Leaves (Plate 339, Fig. 71) about 2 in. long, not exceeding ¾ in. in width, very variable in outline, the central part usually reduced to a narrow fringe on each side of the midrib, basal part with one to four mucronate lobes, apical part expanded; rounded or acute at the apex; entire or toothed and mucronate; dark shining green above, white tomentose beneath.

Fruit ripening in the second year; cupule hemispherical, about ½ in. in diameter, with grey tomentose scales, red at the tips, irregular in size, the shorter ovate and appressed, the longer lanceolate-acuminate and slightly spreading, less numerous than the others and irregularly disposed; acorn depressed at the apex, with a conical tomentose umbo.

This peculiar variety, the history[1] of which is unknown, has leaves similar in form, but smaller and more coriaceous than those of var. *heterophylla*, from which it differs strikingly in habit and in fruit. Two trees, about 20 ft. high, in Kew Gardens were procured from Smith of Worcester in 1877.

9. *Quercus Pseudosuber*,[2] Santi, *Viaggio al Montamiata di Giorgio Santi*, i. 150, t. 3 (Pisa, 1795).

*Quercus Fontanesii*, Gussone, *Index Sem. Hort. Boccadifalco*,[3] 10 (1826).

Under these names a number of wild trees, which so far as we can learn, only occur sporadically in the neighbourhood of their supposed parents, have been described, which are probably hybrid forms between *Q. Suber* and *Q. Cerris*. The original tree, described by Santi, was found near Florence; others were seen by Gussone in Sicily and Calabria. Kotschy mentions isolated trees in Istria, at Pisino-Corridaro, Carpizza, and near Capo d'Istria. It is also recorded from the neighbourhood of Grasse, in Provence. Specimens from Italy in the British Museum resemble in foliage *Q. Lucombeana*, var. *suberosa*. Both *Q. Pseudosuber* and *Q. Fontanesii* were said to have been introduced into cultivation in Loudon's time; but if any survive, we see no means by which they can be distinguished from the seedling forms of *Q. Lucombeana*. (A. H.)

*Q. Pseudosuber* has been treated by some French botanists as a species, whilst others consider it to be a hybrid between *Q. Suber* and *Q. Cerris*. In order to solve this question I visited the district in which it has been found, near Grasse, in January 1910, and after some inquiry found the only two trees known to M. Richard, the forest officer of Montauroux. One of these grows by the side of a rivulet close to the house of Mr. Nelson, manager of the Mine de Vaux, a coal mine which is being worked by an English company about three miles south of Montauroux, on the road to Frejus. The largest of these is a tree about 55 ft. by 3 ft. 3 in., with an upright habit, differing from all the other oaks which grew near it, namely the cork oak and *Q. lanuginosa* (locally known as *Chêne blanc*). The bark, of which I took a specimen, is corky, but much thinner than that of the cork oak; the leaves are hardly distinguishable from those of the Lucombe oak,[1] and are subevergreen, though many of those near the top of both trees had fallen. The other tree, about 50 yds. to the north of the same house, is also by a rivulet, and resembles the first precisely in habit and bark, though the leaves differ slightly.[2] I could find no trees of *Q. Cerris* anywhere in the neighbourhood, and was inclined to believe that *Q. lanuginosa* and not *Q. Cerris* is the other parent. The tree is known in the Provençal patois of the district as *Drouin*. M. Pardé[3] spells this name *Drouis* or *Drouino*.

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[1] Its corky bark and acorns ripening in the second year exclude it from being a variety of *Q. Ilex*. It is incorrectly identified in *Kew Handlist of Trees*, loc. cit., with var. *incisa*.

[2] *Q. Pseudosuber*, Desfontaines, is of totally different origin, being the hybrid between *Q. Mirbeckii* and *Q. Suber* which is found in Algeria. See p. 1319.

[3] Boccadifalco, where there was formerly a Royal Garden, is near Palermo.

M. Coufourier, a botanist of Hyères, gave me a specimen from another tree growing in the "Fond des Gavôts" between Montauroux and Grasse, where he said he had seen no *Quercus Cerris*, though it is reported to occur in the district. He afterwards sent me acorns from the same place which confirm the opinion that *Q. Cerris* and not *Q. lanuginosa* is the parent.

During a visit to Italy and Sicily in March 1910, I saw in the herbarium of M. Sommier of Florence, a number of specimens identified with *Q. Pseudosuber* from various places in Tuscany and other parts of Italy. These varied extremely in their foliage. In the Botanic Garden at Florence there is a fine tree about 60 ft. by 6 ft. named *Q. Pseudosuber*.

In Sicily I was directed by Signor Lojacano[4] to a place called Ficuzza about 25 miles south-east of Palermo where there is a large oak wood in which a few specimens of *Q. Pseudosuber* or *Fontanesi* are found. The forest guard, who knew them under the name of *falso-sughero* (False-cork), guided me to a spot about two miles from the village, where five or six trees were growing scattered in a wood mainly composed of *Q. sessiliflora*, here called *robore*; with some trees of *Q. Ilex* (*ilice*), *Q. Suber* (*sughero*), and *Q. Cerris* (*Cerro*). He considered the two latter to be the parents of the *falso-sughero*, and said that the hybrids produced acorns rarely. The largest tree was very similar in habit to the French trees above mentioned, about 60 ft. by 5 ft., with a hard but slightly corky bark, of which I took a specimen. The leaves were still mostly green on March 3rd, at an elevation of about 1500 ft.

## REMARKABLE TREES

All the original Lucombe oaks are extremely uniform in their habit, bark, and foliage; they show no resemblance in their bark to the cork oak; and all are characterised by a peculiar swelling at the base of the limbs, which I have only seen in the Turkey oak, and by an extremely vigorous growth and an upright habit. I formerly supposed the tree from which they were propagated, to have been, as Holwell states,[1] a very vigorous seedling of the Turkey oak which, in the climate of south Devon and Cornwall, where alone this form can be seen at its best, kept its leaves in winter; and I have raised from acorns of the large Turkey oak, growing near the pond at Kew, two seedlings which up to the age of five years have this subevergreen habit. The seedlings of the original Lucombe oaks, of which the two largest specimens grew near the entrance of the old Exeter Nursery and are now both cut down, had a different habit and much more corky bark, and with the exception of a tree near the chapel at Killerton which, however, is not nearly as large, I have seen no others which could compare with them. None of those propagated later ever seem to have attained the size or vigour of the original Lucombe oak, and none of the seedlings which are on their own roots, show any promise of rivalling the original grafted trees in height or girth. There is no doubt that the original Lucombe oaks which I mention as follows, are among the finest ornamental trees in Great Britain, and deserve to be propagated by grafting in the same way as Lucombe did. For none of those we have seen which have been sold by nurserymen in the last century as Lucombe oaks, can be compared in size or vigour with the originals.

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[1] A microscopical examination of the leaves of these trees by Mr. Boodle of the Kew Laboratory shows no evidence ot the influence of *Q. lanuginosa*, which has four (sometimes only two) ray-cells in the stellate hairs on the under side of the leaf, whereas in *Q. Pseudosuber* and *Q. Suber* there are seven to twelve ray-cells.

[2] The specimens from the three trees near Montauroux—two seen by Elwes and one observed by Coufourier—all differ in foliage, showing that all three are probably descendants of the first cross between *Q. Suber* and *Q. Cerris*. The acorn-cupules, sent by Coufourier, are slightly different from any that I have seen on English trees; and have long reflexed marginal scales and short and spreading basal and median scales. The acorns are depressed at the apex, which bears a minute tomentose umbo.—(A.H.)

[3] *Arb. Nat. des Barres*, 296 (1906). M. Pardé informs me that the trees here mentioned at Les Barres cannot now be found.

[4] The oaks of Sicily have been most carefully studied and described by Signor Lojacano, who recognises in his *Flora Sicula*, iv. pp. 364-389 (1904), no less than thirty-three species and hybrids, specimens of which I examined in the herbarium of the Botanic Garden at Palermo. In this garden there is a good-sized tree of *Q. Pseudosuber*, and in the Botanic Garden at Catania another fine tree about 50 ft. by 4 ft. which produces large acorns freely.

In Cornwall the largest I have seen are at Carclew. One of these in a walk leading to the gardens, was believed by Sir Charles Lemon, who formerly owned Carclew, to have been an original Lucombe oak, and from his notebook, which the late Colonel Tremayne showed me, I took the following measurements:—

In 1823 . . 74½ ft. by 6 ft. 11 in. at 4 ft. from ground.
In 1851 . . " 9 " 1 " " "
In 1853 . . " 9 " 8 " " "

When I saw it in 1903 it was about 100 ft. high by 13 ft. I have not seen any of its acorns, which, Mr. Simmons, the gardener, told me, are rarely produced. At Carclew, in the park, there are four other trees of similar appearance and grafted in the same way which measure from 90 to 100 ft. by 10 to 12 ft. in girth.

Mr. Napper states that a very fine one stands by the Lodge Gate at Trebarrick, St. Austell; and I am informed by Mr. J. P. Rogers that there are at Penrose, near Helston, some large Lucombe oaks planted about 1773 and grafted on the Turkey oak, which are no doubt original.

In Devonshire the tree by the gardens at Killerton (Plate 321) in 1908 measured about 100 ft. by 12 ft. 11 in. At Powderham in the deer park two trees measured in 1906, 92 ft. by 14 ft. 4 in. and 90 ft. by 13 ft. 4 in. At Ugbrooke Park, Devon, the seat of Lord Clifford of Chudleigh, there are four fine trees in the park near the house, of which the largest in 1908 measured 80 ft. by 16 ft.; another about 80 ft. by 14 ft. At Castle Hill, Devon, a tree on the lawn, which I am told by the Hon. J. W. Fortescue was planted in 1770, in 1905 measured 80 ft. by 15 ft. 8 in. (Plate 320). At Sharpham, near Totnes, just below the house, a rather spreading tree was 90 ft. by 13 ft. 4 in. in 1907. At Kingston Lacy, Dorsetshire, there is a tree 90 ft. by 8 ft., with a clean bole about 40 ft. long. At Sherborne Castle, Dorsetshire, a tree measures about 75 ft. high, and 12 ft. 9 in. in girth at 3 ft. At Corsham Court, Wilts, there are two trees, one 80 ft. by 6 ft. 9 in., which is grafted on the common oak, the other 80 ft. by 7 ft. with a straight clean bole of 40 ft. At Longleat, Wilts, Col. Thynne measured one in 1903, 78 ft. by 11 ft. 10 in. At Bowood, Wilts, I saw a handsome tree in 1906, 92 ft. by 9 ft. At Croome Court a tree 74 ft. by 10½ ft., which on 4th June 1906 still bore some leaves of the previous year, showed no graft mark at the ground, which indicates that it may be a seedling of more recent origin. At White Knights, Berks, in the grounds of the Wilderness, a tree of moderate size is grafted on the common oak. At Kew a very fine tree, which also appears to have been grafted on the common oak, measured, in 1907, 74 ft. by 12 ft. 3 in.

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[1] Cf. *Gard. Chron.* xxxii. 195, 221 (1902). The original Lucombe oak appears, however, to have been a chance hybrid of *Q. Cerris* with *Q. Suber*, and not a seminal sport of the Turkey oak.

In Wales the only tree that I know is at Stackpole Court. It measured in 1906, 76 ft. by 6 ft. 8 in.

In Scotland I have seen one tree which looks like an original Lucombe oak; it grows in the park at Dunkeld, near the Abbey ruin, and measured in 1904, 62 ft. by 7 ft. 9 in.

In Ireland the only tree I have seen which looks like an original, is one in the grounds of Kilmacurragh, said to have been purchased by Mrs. Acton over a hundred years ago; and when I saw it in 1908 was 78 ft. by 7 ft., with a clean bole of about 40 ft.

Loudon quotes a letter from Pince as follows: "When the original tree had attained 20 years' growth, and was about 3 ft. in circumference, Mr. Lucombe, being then far advanced in years, had it cut down for the purpose of making his coffin out of it. He, however, lived so much longer than he anticipated, that several years before his death, he had another much larger and older tree cut down, sawn into planks, and carefully deposited under his bed in readiness for the above purpose; and inside those planks, over which for many years he had reposed, he was at length put to rest, at the advanced age of 102 years." Of this tree I possess a relic in the shape of a corner piece, which I bought at a sale of the effects of Mrs. Woodman, a granddaughter of Mr. Pince, who told me that it was made with other furniture from the tree above mentioned. The wood is fine and close-grained, showing a good deal of figure, and of a pale yellowish brown. It has not shown the least symptoms of warping or decay, and is untouched by wood-boring beetles.

The seedlings of the original Lucombe oak are quite different in habit, bark, and character, and show their origin very clearly in the corky nature of the bark. The two largest trees of this kind that existed, so far as I know, grew on each side of the entrance of the old Exeter Nursery. One, stated by Napper to be the original var. *crispa*[1] of Loudon, was 12 ft. in girth in 1891. I am informed by Mr. Robert Veitch, of Exeter, that it was cut down some years ago, and I could find no trace of it. The second, when I visited Exeter in 1902, was standing on the west side of the nursery gate, and measured about 60 ft. by

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[1] Cf. Loudon, fig. 1718, who gives its dimensions in 1838 as 63 ft. high and 9 ft. in girth. It was raised, as above stated, as a seedling in 1792.

10 ft. with a straight clean bole of 22 ft. This, according to Napper, was the original var. *suberosa* of Loudon. It was cut down the year afterwards, when the nursery was sold for building, and I bought the log, containing about 80 ft. in the butt only, for £2. It turned out some very sound hard wood, which, when sawn on the quarter, showed a very varied and beautiful figure. A board from this tree, showing the bark, is now in the museum at Kew, and a cabinet which I had made from it is extremely handsome.

The only other large tree which I know of similar character, and almost certainly of the same origin, grows near the chapel at Killerton, and measures about 60 ft. by 8 ft., with a bole 15 ft. long; its bark is very corky, and it produces acorns much more abundantly than the larger original Lucombe oak at the same place; its leaves are smaller than those of the latter. I have raised a number of seedlings from this tree which vary a good deal, and are too tender to grow well on my soil, which does not suit either of the parents.

Another very fine tree which I believe to have been of the same origin, though its leaves resemble rather those of the Fulham oak, grows at Redleaf, near Penshurst, Kent, the seat of Mrs. E. Hills. This tree shows in its bark that the cork oak was one of its parents, and has no visible mark of having been grafted. It measures 86 ft. by 9 ft. 10 in., with a clean bole about 20 ft. long, and is a handsome and vigorous tree.

There are numerous seedling forms in cultivation, which vary considerably in their foliage, habit, and in the period which they shed their old leaves. Most of them are of very inferior size to the original tree, and the grafted plants, which are usually sold under the name of Lucombe oaks, are, so far as I have seen, slow growers even in the south-west of England. A good example of this may be seen at Powderham Rectory, the residence of the twelfth Earl of Devon, where an avenue of Lucombe oaks was planted, as he told me, about fifty years ago, which, though they came from Lucombe and Pince's nursery, will never rival their parent trees.

There are a number of trees at Syon, which appear in the old catalogue under various names, and which resemble the Lucombe or Fulham oak in their leaves and subevergreen character, but which are not typical of either in their habit. These are most probably seedlings from the Fulham Nursery, but one of them grafted on the common oak, is probably a graft from the original Fulham oak, and measures 81 ft. by 9 ft. 4 in.

The tree does not come true from acorns, as Mr. Napper says that he was in the habit of gathering them, and that they invariably produced what he knew as bastard oaks, more like the Ilex than anything else; and Lord Ducie, who has raised them, tells me the same thing. I found several pans of seedlings of a so-called Lucombe oak in the St. John's nursery at Worcester in 1902, one of which had made in the first year about 18 in. of growth, but this was not made in one uninterrupted shoot as described in the original, but in two separate periods of growth as usual in the English oak. (H. J. E.)

## QUERCUS ÆGILOPS, Valonia Oak

*Quercus Ægilops*, Linnæus, *Sp. Pl.* 996 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1861 (1838).
*Quercus ithaburensis*, Decaisne, in *Ann. Nat. Sc.* iv. 348 (1835).
*Quercus græca*, Kotschy, *Eichen*, t. 30 (1862).
*Quercus macrolepis*, Kotschy, *Eichen*, t. 16 (1862); A. de Candolle, *Prod.* xvi. 2, p. 45 (1864).
*Quercus Ungeri*, Kotschy, *Eichen*, t. 13 (1862).
*Quercus Vallonea*, Kotschy, *Eichen*, t. 7 (1862); A. de Candolle, *Prod.* xvi. 2, p. 45 (1864).

A tree, attaining in the Levant, in good moist soil, about 80 ft. in height, but seldom reaching more than 30 to 40 ft. in arid situations. Bark deeply divided into small square scaly plates.

Young branchlets covered with a dense greyish tomentum, persistent in the second year. Buds ovoid-prismatic, about ¼ in. long, tapering to an acute or rounded apex, tomentose, usually surrounded by long linear pubescent stipules. Leaves (Plate 335, Fig. 19) deciduous late in autumn or in the following spring, 3 to 4 in. long, and 1½ to 2 in. broad, oval or oblong; base usually broad and rounded, occasionally cuneate, subcordate, or auricled; apex acute; with five or six pairs of lateral nerves, prominent beneath, each ending in a large triangular bristle-pointed tooth or lobule; leaf margin and bristles ciliate; upper surface shining, with scattered short stellate pubescence; lower surface covered with a grey short tomentum, occasionally more or less deciduous between the nerves; petiole, ¼ to 1 in. long, tomentose.

Fruit ripening in the second year, sub-sessile, usually solitary; acorn subglobose and scarcely exserted or cylindrical and projecting, ¾ to 1½ in. long, depressed and whitish tomentose at the apex, chestnut brown and glabrescent elsewhere; cupule ½ to 2 in. broad, variable in the shape and consistence of the scales, but broadly distinguishable into two varieties, which are connected by numerous intermediate forms.

1. Var. *macrolepis* (var. *græca*). Cupule hemispheric; scales loosely superposed, thin and ligulate, tomentose, ¼ to ¾ in. long, spreading or erect, often recurved. This form is prevalent in Greece and the adjoining islands.

2. Var. *Ungeri* (var. *ithaburensis*). Cupule sub-globose; scales fewer, thickened, pyramidate, tomentose, ¼ to ½ in. long, spreading or erect, sometimes recurved. This form is prevalent in Asia Minor.

*Quercus Pyrami*, Kotschy, *Eichen*, t. 3 (1862), which is often considered to be a variety of this species—var. *Pyrami*, Boissier, *Fl. Orientalis*, iv. 1172 (1879)—differs considerably in foliage and is quite distinct for purposes of cultivation. As seen at Kew, where it is a small tree about 20 ft. high, the leaves (Plate 335, Fig. 20) are smaller, about 2½ in. long and 1½ in. broad, often indented below the middle with a deep sinus on one or both sides; lateral nerves six to eight pairs ending in short mucronate teeth. According to Kotschy, *Q. Pyrami* grows in the plain of Cilicia, forming large woods at the mouth of the river Pyramus. (A. H.)

### Distribution

This species is widely spread throughout Greece and the adjoining islands, either solitary or forming small woods. Mr. F. B. Wood, British Consul at Patras, informs us that in that district it is abundant and attains large dimensions. A tree of which he sends a sketch, is about 60 ft. high, and 13 ft. or more in girth at 3 ft. from the ground, above the spreading roots. The tree flourishes equally well in various soils. The forest in Elis grows in a plain of rich loam, where myrtle, arbutus, and lentisk are found in profusion. In late spring this oak forest with its carpet of bracken, mixed with asphodel, crocus, and countless wild flowers, is very beautiful. In Acarnania and Etolia the trees grow on rocky hill-sides, amongst wild sage and thorn. In Elis and Achaia a yellow-berried mistletoe (*Loranthus europæus*) is found on every second oak.

The Valonia oak is also widely spread throughout Asia Minor[1] and Crete. According to Sir Joseph Hooker,[2] "it is very gregarious in Syria, never forming a bush or growth of underwood, but rising on a stout gnarled trunk 3 to 7 ft. in girth, to the height of 20 to 30 ft. Wherever we saw it, as on the hills east of Nazareth, on Tabor where it is abundant, to the east of Caifa, and on the north-east flank of Carmel, it forms scattered, rather round-headed, densely leafy trees, giving an open park-like appearance to the landscape. The wood is said to be excellent. The acorn often attains a very large size, some we gathered were 2½ in. long and 3 in. in girth, but they vary extremely on the same tree, some being so small that I have had difficulty in distinguishing between them and large ones of *Q. pseudococcifera.* I have examples which if they had not been taken by myself from an Ægilops tree which also bore large acorns, I should have attributed to hybridisation between the two. When fully ripe the gland is still green, and in this state it germinates, the pericarp never hardening. They may be seen in all the bazaars, raw and boiled, in which state they are eaten by Turks and Arabs."

Gay says that in the Jardin des Plantes on 14th November 1862, he found the acorns of a chestnut brown colour and with a nutty flavour; and this was the case with acorns from Greece which I tasted, and found slightly astringent, but quite edible.

### Cultivation

According to Loudon this species was introduced as long ago as 1731, but it has always been a rare tree, and probably requires more summer heat than our climate affords. The acorns are often sent from the Levant, but seem to lose their vitality quickly. I received some of remarkably large size in January 1909 from Mr. Wood, which have made nice young seedlings in pots.

In Gay's herbarium, at Kew, there is a specimen from a tree growing in the kitchen garden at Milford House, dated September 1859, and a note to the effect that it was introduced by P. Barker Webb. I visited this place in 1909, but could find no trace of this tree, though a small stunted tree exists in another part of the grounds.

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[1] Balansa in a note preserved in Gay's herbarium says that in the neighbourhood of Ushak (or Oushag or Uschak), this oak forms vast forests, and the collection of the cupules was an important industry. At that time they were worth about 2d. a pound, one tree producing about ten pounds.

[2] In *Trans. Linn. Soc.* xxiii. 385 (1862).

At Abbotsbury there is a tree measuring 45 to 50 ft. high by 4 ft. 4 in. in girth, which in 1908 produced half-matured acorns. At Devonshurst, Chiswick, Henry found a branching tree of no great height, but 4 ft. 3 in. in girth.

At Hardwick, near Bury St. Edmunds, I found a small tree about 30 ft. by 4 ft.

At Tortworth a tree is growing on the lawn below the house, which was planted about 1846 by the late Lord Ducie and transplanted when about 10 ft. high to its present situation. It is now about 40 ft. high and produces abortive acorns almost every year, but once produced a ripe acorn which was sent to Kew. At Blenheim, Mr. A. B. Jackson measured a tree 37 ft. by 3 ft. 6 in. dividing into two stems at about 5 ft. from the ground.

Sir C. T. D. Acland has raised plants at Holnicote, which now vary from 1½ to 5 ft. high, from acorns gathered at Patras which were sown in 1899.

At Lyndon Hall, Rutland, there is a fine healthy tree, 30 ft. by 5 ft. in 1909 (Plate 322).

At Syon a tree was reported by Loudon in 1838 to be 22 ft. high and 3 ft. in girth; the only others in England known to him were at Llanbedr Hall, near Ruthin, and at Finborough Hall, Suffolk; all of these seem to have disappeared.

Loudon mentions[1] a tree at Oriel Temple, in Ireland, 55 ft. high in 1838; but I could find no trace of it in 1908.

In France it is hardy at Les Barres, where a specimen[2] 33 ft. high and 5 ft. in girth rarely produces fertile acorns.

The Valonia oak was introduced[3] into Algeria about 1860 by M. Hardy, but though trees are to be found there about forty years old and flourishing, no plantations on a commercial scale appear to have been made. The credit of the introduction[4] of this tree into Australia is due to Mr. George Cunnack, tanner at Castlemaine, Victoria, who imported from Smyrna in 1879 two Wardian cases, one containing rooted young plants and the other acorns covered with earth. They both arrived in good condition, the acorns having sprouted during the voyage, and produced some hundreds of plants.

## VALONIA, MANNA

Valonia[5] is the name for the cups of the acorns of *Q. Ægilops*, which for many years have been imported from the Levant for tanning.

According to Loudon who quotes M'Culloch, in 1831-32 the import amounted to 7500 tons per annum, worth £12 to £15 per ton. Consul Wood of Patras informs me that though the export from Greece alone in 1896 was over 8000 tons, the price has now fallen to £7 or £8, which scarcely covers the cost of collecting and cleaning. In 1906 the export had fallen to 3900 tons, and it seems as though it would die out altogether. He adds that the figures apply to the cupule alone and not to the acorn also, which is discarded before shipment.

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[1] *Arb. et Frut. Brit.* i. 109 (1838).

[2] Figured by Pardé, *Arb. Nat. des Barres*, 293, t. 29 (1906). The specimen which we have of a tree called *Q. macrolepis* at Les Barres agrees well with *Q. Pyrami.* Albert et Jahandiez, *Plant. Vasc. du Var*, 447, note 1 (1908), state that *Q. Ægilops* is cultivated in the department of Var, and is occasionally found in woods there in a semi-wild state.

[3] Trabut, *Le Chêne Vélani*, issued as Bull. 27 by the Agricultural Department of Algeria in April 1901.

[4] Maiden, *The Valonia Oak, New South Wales, Dept. Agric. Misc. Public.* No. 313 (1899).

[5] Sir W. Thiselton Dyer tells us that *valonia* takes its name from Avlona or Valona, a port in Albania, whence it is exported.

Professor Procter of Leeds University informs me that the import has diminished owing to the competition of oak and chestnut extracts, and other tanning materials in the extract form. Valonia extract is now made at Smyrna and may have a considerable future. Greek valonia is well known in the trade and usually averages lower in price than the Smyrna article. As a rule it is less in strength, but good samples of Greek are often better than anything but the best Smyrna. The ripe valonia, either Greek or Smyrna, consists of cups only; but Greek *camata* and *camatina*, are unripe varieties valued for their colour. In *camatina* the acorn is completely enclosed by the unopened cup; in *camata* the acorn shows, but cannot be removed. He cannot say definitely whether any import comes from Syra or Crete, but Greek island valonia is a well-known commodity and often good.

The Valonia oak and an allied species, *Q. persica*, Jaubert et Spach, yield a kind of manna in Kurdistan. These trees are visited in August by immense numbers of a small white *coccus*, from the puncture of which a saccharine fluid exudes and solidifies in little grains. This exudation is collected by the wandering tribes of Diarbekir, who use it as food. A complete account of this peculiar substance is given by Flückiger and Hanbury.[1] (H. J. E.)

## QUERCUS CASTANEÆFOLIA, Chestnut-leaved Oak

*Quercus castaneæfolia*, Meyer, *Verz. kauk. Pflz.* 44 (1831); Mathieu, *Flore Forestière*, 367 (1897).
*Quercus Afares*, Pomel, *Nouv. Mat. Flore Atlantique*, 391 (1874).

A tree, attaining 100 ft. in height and 10 ft. in girth. Bark deeply divided into longitudinal slightly scaly ridges. Young branchlets covered with a minute dense pubescence. Buds (Plate 78, Fig. 4) ovoid, pubescent, those near the apex of the branchlet surrounded by persistent long filiform pubescent stipules. Leaves (Plate 337, Fig. 47) deciduous in autumn, oblong-elliptical, acuminate at the apex, rounded and unequal or cuneate at the base, 3 to 6 in. long, 1½ to 2½ in. wide; with 8 to 14 pairs of lateral nerves, each ending in a mucronate triangular tooth; upper surface dark green, shining, with deciduous minute white stellate hairs; lower surface paler, coated with a minute tomentum; petiole ½ to ¾ in. long, pubescent.

Fruit ripening in the second year, solitary or rarely in clusters of two to six, on a stout short pubescent peduncle; acorn ovoid-cylindrical, ¾ to 1¼ in. long, glabrous, rounded at the apex, which is crowned by the tomentose style; cupule hemispheric,

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[1] *Pharmacographia*, 415 (1879). Virgil, *Ecl.* iv. 30, refers to honeydew on oak, and not to manna, as alleged by Hanbury.

¾ to 1 in. wide, with tomentose scales, reflexed from near their bases, long and linear in the upper ranks, ovate and short elsewhere, but very variable in length and shape.

This species has a remarkable distribution, occurring both in Algeria and in the eastern Caucasus and northern Persia. The characters, upon which Pomel tried to separate the Algerian tree as a distinct species, are unreliable. As seen, however, in cultivation and described by travellers in the wild state, the Caucasian or typical form is characterised by its short trunk and widely spreading horizontal branches, with a bark darker in colour and smoother than in the Algerian form. The latter is narrowly pyramidal in habit, with ascending branches, and with a deeply furrowed whitish bark.

This species is restricted in the Caucasus to the province of Talysch, where it grows in the forests from sea-level to 4000 ft. In Persia it is met with in the mountains south of the Caspian Sea. In Algeria it is less widely spread than *Q. Mirbeckii*, being confined to the forests in the mountains near the coast from Kabylia to the borders of Tunis. This oak near El Snab forms a wood at 600 ft. above sea-level; but elsewhere it is usually a tree of higher levels, occurring in the Akfadou forest between 3700 and 5000 ft., where it is mixed with *Q. Mirbeckii*, but is less abundant (Plate 323). On the northern slope of Mt. Babor, *Q. castaneæfolia* grows in company with *Abies numidica* and *Cedrus atlantica*.

*Q. castaneæfolia* is the southern representative of *Q. Cerris* in the same way as *Q. Mirbeckii* replaces *Q. sessiliflora*; and the mixed oak forests in Algeria closely resemble, in their composition, the forests in Servia where the Turkey oak and the sessile oak are mingled together.

In the forest of Akfadou and elsewhere, on the line of contact between the cork oaks of the lower elevations and the mixed forest of *Q. Mirbeckii* and *Q. castaneæfolia* higher up, the latter species and *Q. Suber* form hybrids which are readily distinguishable in winter, as in that season *Q. castaneæfolia* has lost its leaves, while the hybrids are subevergreen and are different from *Q. Suber* in their inferior corky bark and in the shape of the leaves. These hybrids,[1] which bear a striking resemblance to those of the Turkey oak and *Q. Suber*, are very variable in the character of the bark, in the period of fall of the leaves, and in the stature and growth of the trees. Those which are closest to *Q. castaneæfolia* in these characters have been named *Q. numidica*, Trabut;[2] those nearest to *Q. Suber*, *Q. kabylica*, Trabut.[2] (A. H.)

### CULTIVATION

We can find no reliable information as to when or by whom this oak was introduced into England, but it was not known to Loudon except from description.

The only large tree we know of in England is a fine specimen at Kew, near the Palm House, which measured in 1909 about 60 ft. by 9½ ft. It produces fertile acorns in good seasons, from which I have raised seedlings, and these, though they grow slowly, seem perfectly hardy. It is supposed to have been planted about 1843.

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[1] Certain cork oaks in this forest which lose their leaves in winter are also probably hybrids.

[2] In *Bull. Assoc. France Avance. Sc.*, 1886, p. 506, and *Bull. Soc. Bot. France*, xxxvi. 58, 61 (1889).

A smaller tree, growing beside this, is probably the Algerian form, and measures 47 ft. by 3 ft. 1 in. This is perhaps of the same origin as a very thriving narrow pyramidal tree[1] in the oak collection, measuring 34 ft. by 3 ft., which was raised from acorns sent by Playfair from Algeria in 1869.

Another tree at Beauport, near Grinsted's Cottage, is about 35 ft. by 4 ft. 9 in. and has a short bole with rather corky bark, and a very spreading crown.

Henry was informed in Algeria that the wood of this species is similar in its properties to that of *Q. Cerris*, as it has an abundant sapwood and fails in durability. It is hard, heavy, easy to rive, but difficult to work, and is rejected by the railway companies who have been urged in vain by the forestry department of Algeria to use it for sleepers. Up to the present time it has been mainly used for firewood.

(H. J. E.)

## QUERCUS MACEDONICA

*Quercus macedonica*, A. de Candolle, *Prod.* xvi. 2, p. 50 (1864).
*Quercus Grisebachii*, Kotschy, *Eichen*, 3 (1862) (name only); Baldacci, *Riv. Coll. Bot. Alb.* 72 (1892).
*Quercus Ægilops*, Grisebach, *Spicil. Fl. Rum.* 333, excl. syn. (1844) (not Linnæus).
*Quercus ostryæfolia*, Borbas, in *Erdesz. Lap.* xxvi. 932 (1887).

A small tree or large shrub. Young branchlets with a minute scattered pubescence. Buds ovoid, $\frac{1}{8}$ in. long, with glabrous ciliate scales. Leaves (Plate 337, Fig. 41) deciduous late in the season, coriaceous, about $2\frac{1}{2}$ in. long and 1 in. broad, ovate-lanceolate, auricled at the broad base, acute or acuminate at the apex, with nine to twelve pairs of lateral nerves each ending in a short mucronate tooth; margin wrinkled, with the teeth inflexed; upper surface dark green, with minute deciduous scattered brown pubescence; lower surface paler, with a similar pubescence; petiole $\frac{1}{8}$ in. long, minutely pubescent.

Fruit ripening in the second year, solitary, or two to three together, on a very short stout pubescent peduncle; acorn pubescent at the tip, enclosed in the lower half in a hemispherical cupule, about 1 in. in diameter with pubescent scales, the lowest ovate and appressed; the middle scales linear, hooked, and recurved; the uppermost narrow, erect, or incurved.

This species was discovered by Grisebach in Macedonia, in the mountains near Vodena, and occurs in Epirus, Albania, Montenegro, southern Herzegovina, and in south-eastern Italy on the coast between Bari and Gallipoli.[2]

In Herzegovina[3] it is a rare tree, growing in mixture with *Q. Cerris* and *Q. conferta*, in the Dobrava forest near Stolac and in a few other localities. Farther south it is more common, as in the mountains between Lake Scutari and the sea, and throughout Albania, where it grows above the zone of littoral vegetation, in the lower region of the deciduous oak forests up to 2000 or 3000 ft. It forms pure woods of small extent, or is mixed with *Q. Cerris*, *Q. conferta*, *Carpinus orientalis*, *Ostrya*, and *Fraxinus Ornus*.

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[1] It measured 24 ft. by 2 ft. in 1897.

[2] Schneider, *Laubholzkunde*, i. 180 (1904).

[3] Cf. Beck, *Veg. illyr. Länd*, 211 (1901).

This species only attains a moderate size, and can scarcely be expected to form a large tree in England, where the best specimen known to us is at Tortworth, which measured in 1907 about 25 ft. high and 1 ft. 11 in. in girth. The only others we have seen are small trees at Kew, about 10 ft. high, which were raised from acorns sent by Beccari in 1890. Elwes raised a lot of seedlings from acorns sent to Kew in 1905, which seem to thrive on oolite soil, and endured the severe frost of 1908-9 better than *Q. Ilex*. It appears to be perfectly hardy not only in England, but in Germany,[1] where young plants raised at Gotha from acorns gathered by Dr. Perona at Gallipoli are thriving. (A. H.)

## QUERCUS LIBANI

*Quercus Libani*, Olivier, *Voy. Emp. Oth.* ii. 290, t. 32 (1807); De Candolle, *Prod.* xvi. 2, p. 49 (1864); Carrière, in *Rev. Hort.* 1872, p. 155, f. 18; Boissier, *Fl. Orient.* iv. 1173 (1879).

A small tree or large shrub. Young branchlets minutely pubescent. Buds ovoid, acute, ⅛ in. long, with ciliate, glabrous, or pubescent scales. Leaves (Plate 337, Fig. 39) deciduous in autumn, about 3 in. long and ¾ in. wide, lanceolate, acuminate at the apex, rounded and unequal at the base, with nine to twelve pairs of lateral nerves, each ending in a bristle-tipped inflexed[2] serration; both surfaces at first pubescent, usually becoming glabrous in summer, except on the midrib and nerves, where some pubescence is retained; petiole ½ in. long, pubescent.

Fruit ripening in the second year, solitary on short stout pubescent stalks, very variable in size; acorn globose and only slightly projecting beyond the cupule, or cylindrical and half-enclosed by the cupule, depressed and tomentose at the apex; cupule campanulate, ¾ to 1¼ in. in diameter, covered with appressed tomentose ovate-rhombic scales.

This species is extremely variable[3] in the amount of pubescence on the branchlets and leaves, and in the size of the acorn cup, which shows much variation in the size and shape of the scales. Leaves with irregular deep lobes sometimes occur on vigorous young branchlets; and extreme forms of this are *Q. squarrosa*, Kotschy,[4] founded possibly on coppice shoots. *Q. Libani*, which was discovered by Olivier on Mt. Lebanon, is widely spread throughout the mountains of Syria, Asia Minor, and Armenia.

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[1] Schneider, *Laubholzkunde*, i. 180 (1904).

[2] The margin is wrinkled on account of the inflexed teeth, but less so than in *Q. macedonica*.

[3] *Quercus regia*, Lindley, *Bot. Reg.* t. 73 (1840); *Q. vesca*, Kotschy, *Eichen*, t. 11 (1862); and *Q. Tchihatchewi*, Kotschy, in Tchihatcheff, *As. Min.* ii. 468, t. 40, f. 1 (1860), are united with *Q. Libani* by Boissier, and are perhaps extreme forms of this very variable species.

[4] *Ex* De Candolle, *Prod.* xvi. 2, p. 108 (1864).

The oldest plants in Europe were apparently raised at Paris, from acorns sent by Balansa in 1855. A healthy tree in the Jardin des Plantes at Paris produces acorns; and it is quite hardy at Les Barres. This species is extremely rare in England. The best is a grafted tree at Kew, about 25 ft. high, with a good leader, which was obtained under the name *Q. serrata pendula*, from Lee's nursery in 1880. A smaller tree, about 15 ft. high, obtained from Paris in 1883, bore a few acorns in 1909. There are also specimens at Tortworth, Grayswood, and Aldenham. The latter, a healthy young tree, produced ripe fruit in 1908. (A. H.)

## QUERCUS SERRATA

*Quercus serrata*, Thunberg, *Fl. Jap.* 176 (1784); Franchet et Savatier, *Enum. Pl. Jap.* i. 447 (1875); Hooker, *Fl. Brit. India*, v. 601 (1888); Skan, in *Journ. Linn. Soc.* (*Bot.*) xxvi. 520 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 51, t. 26, figs. 1-12 (1900); Gamble, *Indian Timbers*, 673 (1902).

A tree, attaining usually about 40 ft. in height. Young branchlets silky pubescent when young, soon becoming glabrescent; smooth and shining in the second year. Leaves (Plate 337, Fig. 46) deciduous in autumn, 4 to 8 in. long, 1 to 2 in. wide, oblong-lanceolate, acuminate at the apex, cuneate or rounded at the base, with ten to sixteen pairs of lateral nerves, each ending in a bristle-tipped serration; upper surface glabrescent; lower surface green, with deciduous appressed pubescence, glabrous in summer except for slight stellate-pubescent axil-tufts; margin non-ciliate; petiole ½ to 1 in. long, with scattered pubescence.

Fruit ripening in the second year, solitary or in pairs, sub-sessile; acorn ellipsoid, glabrous, scarcely longer than the hemispherical cupule, which is ¾ to 1¼ in. in diameter, covered with tomentose scales, those at the base ovate-oblong, those above linear, ½ to 1 in. long, more or less spreading.

This species is widely distributed, occurring in Japan, China, the Shan and Khasia Hills, and in the Himalayas, through Bhutan and Sikkim to eastern Nepal. In Japan, Sargent saw it growing on dry soil near the coast behind Yokohama, and on the foothills of central Hondo. Gamble states that it has been largely planted at the cinchona plantations near Darjeeling and succeeded admirably. It has also done well at Dehra Dun, where a tree felled in the garden of the Forest School showed a growth of two to three rings per inch of radius.

Gay[1] states that four plants of this species, about 3 ft. high, were growing in 1861 at Verrières, near Paris, where they had been raised from acorns sent from Manchuria by Montigny; but these do not appear to have survived.[2] Maximowicz in 1864 introduced *Q. serrata* from Japan into the St. Petersburg Botanic Garden.[3]

It is probable that this species was introduced into England by Oldham, who collected in Japan, China, and Korea in 1861-64, as a small tree in Kew Gardens, about 20 ft. high, is labelled with his name. Younger specimens, received from

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[1] Note in Kew Herbarium.

[2] In *Hortus Vilmorinianus*, 55 (1906), mention is only made of young plants of this species, raised from Chinese acorns, obtained a few years ago.

[3] Bretschneider, *Hist. Europ. Bot. Disc. China*, 609 (1898).

Veitch in 1893, appear to be more vigorous. At Beauport, Sussex, there is a good specimen, which measured about 40 ft. by 3 ft. 3 in. in 1905. At Bicton, a healthy specimen is about 35 ft. by 5 ft. There is also a good tree in Coombe Wood.

This is one of the oaks in China on which some species of wild silkworm feed; but Mayr,[1] who says that it is not hardy at Grafrath, states that the great expectations of its successful cultivation in southern Europe as food for the silkworm of *Saturnia Yama-mai* have not been fulfilled. (A. H.)

## QUERCUS VARIABILIS

*Quercus variabilis*, Blume, in *Mus. Bot. Lugd. Bat.* i. 297 (1849); Shirasawa, *Icon. Ess. Forest. Japon*, text 54, t. 28, figs. 1-11 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 510 (1906).

*Quercus chinensis*, Bunge, *Enum. Pl. China*, 61 (1835) (not Abel); De Candolle, *Prod.* xvi. 2, p. 50 (1864).

*Quercus acutissima*, Carruthers, in *Journ. Linn. Soc.* (*Bot.*) vi. 33 (1861).

*Quercus Bungeana*, Forbes, in *Journ. Bot.* xxii. 83, 85 (1884); Skan, in *Journ. Linn. Soc.* (*Bot.*) xxvi. 508 (1899).

*Quercus serrata*, Thunberg, var. *chinensis*, Wenzig, in *Jahrb. bot. Gart. Berlin*, iv. 221 (1886).

A tree, attaining 80 ft. in height and 10 ft. in girth. Bark grey, thick, corky. Young branchlets as in *Q. serrata.* Leaves (Plate 337, Fig. 40) similar to those of that species, but covered beneath with a dense white tomentum. Fruit with smaller cupules, which have thicker shorter scales.

This species, which is very closely allied to, if not a mere variety of *Q. serrata*, is spread through Japan, Korea, and China, where it is very common about Peking, attaining in the western hills a height of 60 to 80 ft. The acorn-cups are used in China for dyeing purposes, and yield a considerable amount of tannin.

This tree produces cork very similar to that yielded by *Q. Suber* in Europe; and the Japanese have commenced to utilise its bark for this purpose. Mayr strongly recommends its cultivation for cork in localities where the common chestnut thrives.

Fortune,[2] in 1861, procured a large quantity of acorns at Peking, from which Standish raised young plants at Bagshot; but we have found no trees of this origin.

It was afterwards introduced by Dr. Bretschneider,[3] who sent acorns from Peking, where the tree is very common, to Prof. Sargent in 1881, and to Kew in 1882, where there is a good specimen about 20 ft. high and growing vigorously. A smaller tree, raised from acorns sent by Regel, is probably of Japanese origin. Sargent[4] says that this species is very hardy in the Arnold Arboretum, U.S.A., and of rapid growth, the leaves turning a bright yellow in November. He[5] also collected acorns in Japan in 1892, from which young plants were raised.

(A. H.)

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[1] *Fremdländ. Wald- u. Parkbäume*, 510 (1906).

[2] *Yedo and Peking*, 382 (1863), and in *Gard. Chron.*, 1863, p. 872.

[3] *Hist. Europ. Bot. Disc. China*, 1061 (1898).

[4] In *Garden and Forest*, iii. 556 (1890).

[5] *Forest Flora Japan*, 68 (1894).

## QUERCUS DENTATA

*Quercus dentata*, Thunberg, *Fl. Jap.* 177 (1784), and *Ic. Pl. Jap.* dec. 5, t. 6 (1794); Franchet et Savatier, *Enum. Pl. Jap.* i. 445 (1875); Sargent, *Forest Flora Japan*, 67, t. 23 (1894); Skan, in *Journ. Linn. Soc.* (*Bot.*), xxvi. 511 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 52, t. 27, figs. 1-15 (1900).

*Quercus obovata*, Bunge, *Enum. Pl. China*, 62 (1835).

*Quercus Daimio*, Koch, *Dendrologie*, ii. 2, p. 45 (1873).

*Quercus yunnanensis*, Franchet, in *Journ. de Bot.* 1899, p. 146.

A tree, occasionally attaining 80 ft. in height and 10 ft. in girth. Young branchlets covered with a dense brownish or greyish tomentum, retained in the second year. Buds tomentose, the terminal one surrounded by persistent stipules. Leaves (Plate 337, Fig. 43) deciduous in autumn, 8 to 12 in. long, 3 to 6 in. broad, obovate, acute or rounded at the apex, cuneate or subcordate at the base, with six to nine pairs of small rounded lobes; margin ciliate; upper surface pubescent on the midrib and nerves, elsewhere glabrous or with scattered hairs; lower surface pale, sparsely covered with a minute stellate pubescence; petiole ¼ to ½ in. long, tomentose.

Fruit ripening in the first year, clustered, sub-sessile or stalked; acorn subglobose; cupule covered with long tomentose scales, those in the basal ranks ovate-oblong, obtuse, and spreading, those towards the rim linear, acute, and reflexed.

This species displays a considerable amount of variation in the wild state, and several varieties[1] have been distinguished, none of which are in cultivation. The following remarkable variety is cultivated in Japanese gardens, but does not seem to have been introduced:—

1. Var. ***pinnatifida***, Matsumura.

*Quercus pinnatifida*, Franchet et Savatier, *Enum. Pl. Jap.* i. 445 (1875), and ii. 497 (1879).

Leaves deeply lobed, almost to the midrib.

This species is a native of Japan, Korea, Chinese Manchuria, and China. In Japan, according to Sargent, it is found in central Hondo only on the high mountains, where it is not at all common; but in the extreme northern part of the island it appears in great numbers on gravelly slopes at no great height above the sea-level. In Yezo, where Elwes collected it at Asahigawa, it grows on low ground with *Q. grosseserrata*, and though it attains a height of 80 ft., is not a fine or imposing tree. Mayr mentions as remarkable its occurrence on volcanic sands, and states that its bark is the most valuable tanning material in Japan, and recommends it for planting on sand dunes. The wood, according to Sargent, is coarse-grained, porous, and brittle, and worthless except for firewood.

In China it is common on poor soil on low hills in the northern provinces, and it extends on the high western plateaux as far south as Mengtze in Yunnan, nowhere, so far as I have observed, attaining considerable dimensions.

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[1] Var. *M'Cormickii*, Skan, *loc. cit.*; var. *oxyloba*, Franchet, in *Journ. de Bot.* xiii. 146 (1899). *Q. yunnanensis*, Franchet, *loc. cit.*, is also a peculiar form, occurring in Yunnan.

This tree was probably introduced into Europe by Siebold, who sent acorns of several Japanese oaks to Leyden in 1830. According to Loudon,[1] young plants were growing in 1842 in the Tooting and Epsom Nurseries. It has never thriven in this country, usually forming a low bushy tree, liable to injury by both spring and late frosts, and seldom displaying its fine foliage to advantage. At Syon, where a specimen is said to be over thirty years old, it has made but little growth. It appears to thrive better in the United States, where it is hardy as far north as eastern Massachusetts.[2] (A. H.)

## QUERCUS ALNIFOLIA

*Quercus alnifolia*, Poech, *Enum. Pl. Cypri*, 12 (1842); Boissier, *Fl. Orient.* iv. 1168 (1879); Schneider, *Laubholzkunde*, i. 183 (1904).

*Quercus cypria*, Jaubert et Spach, *Illust. Pl. Orient.* i. t. 56 (1843).

A shrub or small tree. Young branchlets densely covered with greyish stellate pubescence, retained in the second year. Leaves (Plate 338, Fig. 60) coriaceous, persistent two years, 1½ to 2 in. long and broad, orbicular or obovate; rounded or acute at the apex; rounded or broadly cuneate at the base; with five to eight pairs of prominent lateral nerves, all but the lower one or two pairs, ending in a minute mucronate tooth; upper surface dark green with deciduous stellate hairs; lower surface covered with a dense orange or yellowish grey tomentum;[3] petiole ½ in. long, tomentose.

Fruit ripening in the second year, solitary or two to three on a short tomentose stalk; acorn ½ to 1½ in. long, surrounded at the base by a hemispherical cupule, covered with tomentose scales, the basal ranks ovate and appressed, the median scales lanceolate, and the upper linear scales long and recurved.

This species grows as underwood in the pine forests of the mountains of Cyprus at 1600 to 5000 ft. altitude. It is very rare in cultivation,[4] the only specimens which we have seen being two small trees, about 7 ft. high, at Kew, which were raised from acorns sent by Sir Robert Biddulph in 1885. One of these is in the temperate house and the other is in the oak collection. (A. H.)

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[1] In *Gard. Mag.* xviii. 17, 41 (1842). Bretschneider, in *Hist. Europ. Disc. China*, 1061 (1898), states that he sent acorns from Peking to the Arnold Arboretum, Mass., from which plants were raised.

[2] Sargent, *Silva N. Amer.* viii. 10, note 41 (1895).

[3] In native specimens the tomentum is orange in colour; but in the shrubs at Kew it is only slightly tinged with yellow.

[4] Cf. *Gard. Chron.* xiv. 533 (1880), and xvii. 227 (1882); and *The Garden*, xviii. 486 (1880).

## QUERCUS COCCIFERA, KERMES OAK

*Quercus coccifera*, Linnæus, *Sp. Pl.* 1413 (1764); Loudon, *Arb. et Frut. Brit.* iii. 1908 (1838); Mathieu, *Flore Forestière*, 387 (1897).
*Quercus pseudococcifera*, Desfontaines, *Fl. Atl.* ii. 349 (1799).
*Quercus Mesto*, Boissier, *Voy. Bot. Esp.* ii. 519, t. 166 (1845).
*Quercus anodonta*, Borbas, in *Erdesz. Lap.* xxvi. (1887).

A shrub, usually 6 to 12 ft. high, occasionally becoming a small tree, rarely exceeding 20 ft. in height. Young branchlets with scattered brown stellate pubescence. Buds brown, ovoid, minute, glabrescent. Leaves (Plate 338, Fig. 62) persistent two or three years, coriaceous, variable in size and shape, oval or oblong, 1 to 1½ in. long and ⅞ in. broad, acute or rounded at the apex, sub-cordate or truncate at the base, wrinkled in margin, and with the upper surface concave; with four to eight pairs of minute teeth, each ending in a cartilaginous bristle; glabrous and shining green above and below; petiole ⅛ to ¼ in. long, stellate-pubescent.

Fruit ripening in the second year, solitary or in pairs, sessile or shortly stalked; acorn cylindrical-ovoid, about an inch long, glabrous, shining; cupule hemispheric, ½ to ¾ in. wide, covered with tomentose spine-tipped scales, ovate to linear, and very variable in breadth, thickness, and curvature.

The above description applies to the typical form prevalent in the western part of the Mediterranean region, but considerable variation occurs in the size and shape of the leaves (which are occasionally entire) and of the cupules, cupule-scales, and acorns. These differences appear to depend upon the vigour of the plant, and are occasionally present upon the same individual; and the numerous varieties which have been named can scarcely be upheld. The following, however, are noteworthy:—

1. Var. *Auzandri*, De Candolle, *Prod.* xvi. 2, p. 53 (1864).

*Quercus Auzandri*, Grenier et Godron, *Fl. France*, iii. 119 (1855-6).

Leaves (Plate 339, Fig. 65) more or less stellate-pubescent beneath. Cupules small with scales flattened at the points. This is supposed by Fliche[1] to be a hybrid between *Q. Ilex* and *Q. coccifera*, and has been observed in the south of France and in Algeria.

2. Var. *pseudococcifera*, Boissier, *Flora Orientalis*, iv. 1169 (1879).

Var. *Calliprinos*, Boissier, *loc. cit.*
*Quercus pseudococcifera*, Labillardière, *Ic. Pl. Syriæ, Dec.* v. p. 9, t. 6 (1812), (not Desfontaines),[2] J. D. Hooker, in *Trans. Linn. Soc.* xxiii. 381, tt. 36, 37 (1862).
*Quercus Calliprinos*, Webb, *It. Hisp.* 15 (1838).

The eastern form of the species, often a shrub, occasionally a large tree, Leaves flat, scarcely concave or wrinkled, usually larger than in the type. Fruit variable, but often larger than in the western form.

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[1] In Mathieu, *Flore Forestière*, 389 (1897). Albert et Jahandiez, *Plant. Vas. du Var*, 445, pl. xv. (1908), distinguish four hybrids between *Q. Ilex* and *Q. coccifera*, all of which have been seen in the south of France.

[2] *Q. pseudococcifera*, Desfontaines, described from Algerian specimens, is absolutely identical with *Q. coccifera*.

The Kermes oak is a native of the Mediterranean region, occurring in northern Africa, Spain, and Portugal, the south of France, Italy, Dalmatia, Albania, Greece, Asia Minor, and Syria. It covers dry poor soils with a shrubby vegetation, being often mixed on limestone with *Q. Ilex*. Its bark, especially that of the roots, is much esteemed for tanning, whilst its branches are often covered with an insect (*Chermes Ilicis*) called Kermes in Arabic, which was formerly used like cochineal, as a scarlet dye. (A. H.)

In Asia Minor and Syria this species occasionally becomes a large tree, of which Hooker gives the following account:—"This is by far the most abundant tree throughout Syria, covering the rocky hills of Palestine especially with a dense brushwood of trees 8 to 12 ft. high, branching from the base, thickly covered with small evergreen rigid leaves, and bearing acorns copiously. Owing to the indiscriminate destruction of the forests in Syria this oak rarely attains its full size. We saw but few very good trees, one of which is the famous oak of Mamre called Abraham's oak, of which a portrait is given (Plate xxxvi.), and I saw other good ones at Anturah on the Lebanon. Abraham's oak is supposed to indicate the spot where grew the oak under which the patriarch pitched his tent, and is reverenced by Jews, Mahometans, and Christians. In general habit it much resembles *Q. Ilex* as grown in this country. The diameter of the foliage is given, no doubt correctly, by Porter as 90 ft., the girth of the trunk as 23 ft. In the winter of 1856-57 when in the streets of Jerusalem the snow fell deep and lay for many days, a great branch of Abraham's oak was broken off, and when cut up was sufficient to load seven camels." A more recent photograph in my possession shows that this tree has now been protected by a stone wall, and though its foliage is more scanty than as shown in Hooker's drawing, the tree is still a very fine one.

According to Loudon the species was cultivated as long ago as 1683, but is now rarely seen, except in botanic gardens. At Kew it is perfectly hardy, young Algerian specimens having survived the severe winter of 1860-61, and it occasionally bears fruit. We have specimens from Kew, Eastnor, the Heatherside Nursery near Bagshot, and Fota. At Bitton[1] it forms a bush about 20 ft. high, which was raised from an acorn gathered near Athens in 1854-55. It produces root-suckers freely.

According to Mouillefert,[2] it is hardy at Grignon near Paris, where it has borne a temperature of 5° Fahr. without injury, and thrives well on poor calcareous soil.

(H. J. E.)

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[1] Canon Ellacombe, in *Gard. Chron.*, 1870, p. 1155, says that it produces acorns very freely, but these are nearly always abortive.

[2] *Ess. Forest.* 112 (1903).

## QUERCUS ILEX, Ilex or Holm Oak

*Quercus Ilex*, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1899 (1838); Willkomm, *Forstliche Flora*, 415 (1887); Mathieu, *Flore Forestière*, 374 (1897).
*Quercus Gramuntia*, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1906 (1838).
*Quercus sempervirens*, Miller, *Gard. Dict.* ed. viii. No. 3 (1768).
*Quercus calicina* and *expansa*, Poiret, in Lamarck, *Dict. Suppl.* ii. 216 (1811).
*Quercus ilicifolia*, Salisbury, *Prod.* 392 (1796).
*Quercus pseudoilex*, Chatin, in *Bull. Soc. Bot. France*, xvi. 22 (1869).

A tree, attaining in favourable conditions 90 ft. in height and 20 ft. in girth; often shrubby or of small size in dry climates and on poor soils. Bark of older stems divided into small scaly plates. Young branchlets covered with grey tomentum, retained in the second year. Leaves (Plate 339, Fig. 69) coriaceous, persistent two or three years, very variable in size, shape, and margin, even upon the same tree; larger leaves, often 3 in. long and 1½ in. broad, occurring on vigorous branches and on trees growing in moist climates and in good soils; smaller leaves, often 1 in. long and ½ in. broad, being characteristic of branches of feeble growth and on shrubby trees growing in dry climates and on hot calcareous soils; larger leaves usually ovate or ovate-lanceolate, acuminate at the apex, and tapering at the base; smaller leaves usually oval, acute at the apex, and rounded at the base, but with many intermediate forms; margin entire or undulate on the upper branches of older trees, or with holly-like spine-tipped teeth on lower branches and on young trees; upper surface dark green, shining, with numerous stellate hairs; lower surface usually covered with a dense fine white or greyish tomentum, occasionally glabrescent and light green on branches of young trees; lateral nerves seven to ten pairs, ending in the teeth of dentate leaves, dividing and looping before reaching the margin of entire leaves; petiole ¼ to ¾ in. long, tomentose.

Fruit ripening in the first year, solitary or in pairs, on a short stout grey tomentose peduncle; acorns, very variable in size and shape, often slightly pubescent towards the apex, which is surmounted by a conical umbo, tomentose except for a glabrescent or glabrous narrow basal zone; cupule hemispheric or rarely turbinate, with closely appressed ovate grey tomentose scales, diminishing in size from the base to the margin of the cupule.

### Varieties

Spread over a wide area, occurring in different soils and climates, and showing a large amount of variation in the individual tree, influenced by age, vigour of branchlets, etc.,—this species has numerous forms, impossible to define in the present state of our knowledge, and only a few conspicuous varieties[1] can now be alluded to.

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[1] Albert et Jahandiez, *Plant. Vasc. du Var*, 439, Pl. xi., xii., xiii., xiv. (1908), enumerate and describe thirty-one varieties.

1. Var. *Ballota*, De Candolle, *Prod.* xvi. 2, p. 39 (1864).

*Quercus rotundifolia*, Lamarck, *Encyc. Méth.* i. 723 (1783).
*Quercus Ballota*, Desfontaines, in *Mém. Acad. Sc. Paris*, 1790, p. 394, t. 6, and *Fl. Atlant.* ii. 350 (1800); Webb, *Iter Hisp.* 14 (1838); Loudon, *Arb. et Frut. Brit.* iii. 1905 (1838).

Leaves variable, spiny-dentate or entire, usually rounded at the base and white beneath. Acorns large, sweet, edible.

This variety is the prevalent form in Spain and northern Africa, and occurs also in Portugal, where Coutinho[1] distinguishes another variety, with sweet acorns (var. *avellanæformis*), very small, sub-globose, and almost enclosed in the cupule. Webb says that the leaves in var. *Ballota* always have a round rather than an elliptic shape, and that toothed and entire leaves are mixed on the same branch; the down which clothes them is thicker, the branches stiffer, and the acorns besides being very sweet are much longer and more cylindrical. He also found it more tender[2] than the common form, and said that a specimen which he grew for twenty years in a warm situation only reached 6 ft. high in that time.

2. Var. *Gramuntia*, Loudon, *Trees and Shrubs*, 882 (1842).

*Quercus Gramuntia*, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1906 (1838).
*Quercus Cookii*, Loudon, *Arb. et Frut. Brit.* iii. 1926 (1838).

Leaves (Plate 339, Fig. 68) broadly oval, obovate, or almost orbicular, often sub-cordate at the base, 1 to 1½ in. long; margin wrinkled, with a few inflexed teeth, ending in long sharp spines.

This variety was described by Linnæus from a specimen growing in the wood of Gramont, near Montpellier, where, however, De Candolle afterwards failed to find it. A tree bearing this name was growing in 1838 at Purser's Cross. It was raised in 1835 in the Chiswick Garden from acorns procured from Gibraltar. It is probably a form in which the seedling characters are preserved, and was both by Loudon and by Cook confused with var. *Ballota*. It is a small tree, occasionally seen in gardens, as at Kew and at Osborne, where there was a tree, 36 ft. by 4 ft., in 1908, bearing the name of *Q. Ballota*.

3. Var. *Fordii*, Loudon, *Gard. Mag.* xix. 36 (1843).

*Quercus Fordii*, Koch, *Dendrologie*, ii. 2, p. 56 (1873).

Leaves narrow, lanceolate, 1 to 1½ in. long; margin wrinkled, undulate or with a few irregular teeth, without spiny points. This peculiar form originated many years ago in Lucombe and Pince's nursery at Exeter, and was named after Ford, one of the proprietors.

4. Var. *crispa*, Loudon. As seen at Kew, a monstrous form, with very small entire leaves, about ½ in. in length, with the edges rolled inwards and the under surface concave.

5. Var. *Smilax*, Nicholson, in *Kew Handlist, Trees*, 689 (1902).

*Quercus Smilax*, Linnæus, *Sp. Pl.* 994 (1753).

Leaves entire, narrow, lanceolate, long acuminate at the apex.

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[1] In *Boll. Soc. Brot.* vi. 94 (1888).

[2] The seedlings which Elwes raised at Colesborne were killed by a frost, which left seedlings of the typical form in the same bed unhurt.

6. Var. *Genabii* and var. *latifolia* are forms with very large leaves, up to 5 in. long, and 2½ in. wide, usually dentate towards the apex.

7. In Afghanistan and the western Himalayas, a variety described as a distinct species, *Q. Baloot*, Griffith, *Itin. Notes*, 328 (1848), occurs at altitudes between 3000 and 8500 ft.[1] In western China, several peculiar varieties[2] have been found on the high mountains of Szechwan, Hupeh, and Yunnan. None of these Asiatic forms have been introduced into cultivation, and need not be here further alluded to.

### HYBRIDS

Reputed hybrids between *Q. Ilex* and *Q. Suber* have been reported in France,[3] Italy,[4] Spain,[5] and Portugal.[6] This species also hybridizes with *Q. coccifera.* Cf. p. 1279.

*Q. Turneri*, supposed to be a hybrid between *Q. Ilex* and *Q. pedunculata*, is described on p. 1288. *Q. audleyensis*, possibly a hybrid with *Q. sessiliflora*, is described on p. 1291.

### DISTRIBUTION

*Q. Ilex* is a native of the Mediterranean region, occurring in Spain and Portugal, France, Italy, Southern Tyrol, Istria, Dalmatia, Greece, the coast region of Syria, and in Morocco, Algeria, and Tunis.

In France, *Q. Ilex* occurs in the departments bordering on the Mediterranean, and ascends the valley of the Rhone to a point near Valence, spreading on the east along the valleys of its tributaries through Drôme, Basses-Alpes, and Hautes-Alpes, and being limited on the west by a line passing through the southern parts of Ardêche, Lozère, Aveyron, and Tarn, and including the greater part of Aude and Pyrénées Orientales, where M. Flahaut observed it in the valley of the Tet as high as 5000 ft. elevation. In south-eastern France this species is only met with on limestone, and is rarely seen except as coppice, its bark being a valuable tanning material. At low altitudes and in arid situations it is often mixed with *Pinus halepensis*, and at higher altitudes with *Quercus lanuginosa.* These coppices consist usually of scattered bushes separated by paths frequented by flocks of sheep. The most remarkable forest of this kind is that of Bédoin, on the southern slope of Mt. Ventoux, where *Q. Ilex* ascends from 300 to 2700 ft., occurring pure up to 2300 ft., and mixed with *Q. lanuginosa* between 2300 and 2700 ft. In this coppice is found the most esteemed kind of truffle, that of Périgord.[7] In the south-west and west of France *Q. Ilex* is found here and there on limestone in small groups, in the Basses-Pyrénées, Gironde, Charente, around Nantes and Poitiers; and is reported as far north as Quimper. In France, though limited in the wild state to the milder regions, it bears a considerable degree of winter cold, having sustained without injury at Grignon a temperature of – 23° Cent. in 1871; but in 1879 when the temperature fell to – 26½° Cent. it was killed to the ground, but the root has since produced a vigorous shoot.[1]

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[1] Cf. Hooker, *Fl. Brit. India*, v. 602 (1888).

[2] Cf. Skan in *Journ. Linn. Soc.* (*Bot.*) xxvi. 516 (1899). *Q. Ilex*, var. *phillyræoides*, Franchet, a native of Japan and western China, is very different and is treated by us as a distinct species. See p. 1298.

[3] *Quercus Bertrandi*, Albert et Reynier in *Bull. Acad. Intern. Géog. Bot.*, 1902, *ex* Albert et Jahandiez, *Plant. Vasc. du Var*, 444, pl. xiv. (1908).

[4] *Quercus Morisii*, Borzi, in *Nuov. Giorn. Bot. Ital.* xiii. 10, fig. 1 (1881). This hybrid is reported by Pereira in *Bull. Soc. Bot. France*, xiv. 69 (1892) to occur near Bastia, in Corsica.

[5] Mentioned by Laguna, as occurring in Estremadura and Andalusia.

[6] Continho reports this hybrid to be not uncommon in Alemtejo.

[7] Cf. Huffel, *Économie Forestière*, i. 386-390 (1904).

In Corsica, *Q. Ilex* is a common tree, and forms fine forests in the north-western part of the island. That of Pirio, near Calvi, occupies northern slopes between 600 and 2500 ft. altitude, and contains many large trees, up to 90 ft. in height. (A. H.)

In Italy, *Q. Ilex* is widely spread. Bunbury[2] says that "in the Cascine, near Pisa, mixed with stone pine and pinaster, it forms extensive woods on light sandy soil. The limestone mountains behind Spoleto are entirely clothed with the Ilex; so are those near Terni, around the famous falls of the Velino, and those bounding the valley of the Nar from Terni to Narni. There are many large trees of it on the banks of the Nar near the Bridge of Augustus. The superb Ilexes in the grounds of the Villa Borghese and Villa Pamfili at Rome are celebrated; but the finest trees of the kind that I remember ever to have seen are on the road between Castel Gondolfo and the Capuchin convent above the town of Albano. They are of vast size." I measured a very fine tree, said to be over 150 years old, in the garden of the Hotel Hassler at Naples, formerly belonging to the King of Naples. In March 1910 it was over 90 ft. high and 12½ ft. in girth, and had borne many large acorns, some of which I brought home.

*Q. Ilex* is generally known in Spain as *encina*, but sometimes called *carrasca*, or *chaparro*; and in Portugal is named *azinho* or *azinheira*. It is an extremely variable tree found throughout Spain except perhaps in Galicia, most abundant in the south, where it ascends, near Ronda, to 1500, and in the Sierra Nevada to 2000 metres; and is a most characteristic tree of large tracts in Estremadura and Leon. Widdrington considered it distinct from the common *Ilex* grown in England, and says that he instantly recognised it in a bed of seedlings at Kensington, which on inquiry turned out to have been raised from acorns sent from Valencia by Lord Holland. He adds that it is less hardy, and would barely exist in the north of England, where the Italian form grew well.

In passing through the great open plains which lie between the Portuguese frontier and Ciudad Rodrigo this was almost the only tree that I saw scattered over the country for many miles as a sort of open forest, cultivated with wheat or rye between the trees, or grazed. The trees were heavily pruned like olive trees, to make them produce as many acorns as possible; and these acorns, known as *bellotas*, are looked on as good food for man and beast.

In Portugal the tree is not so common generally as *Q. Suber* and *Q. lusitanica* in the south, or as *Q. pedunculata* and *Q. Toza* in the north; and I saw none of great size; though a tree at Villa Nova de Baronia, in Alemtejo, is recorded by Gebhart as 3·35 metres in girth, with a crown 19 metres in diameter when less than 100 years old, and was said to produce 1000 litres of acorns in one year. The flowering of the tree is earlier in Portugal than that of the cork oak, and so profuse that in April the trees had quite a golden appearance. The timber is valued for cart wheels and other farm implements, and preferred to that of the cork oak. It is also largely used for firewood and charcoal.

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[1] Cf. Mouillefert, *Essences Forestières*, 104 (1903).

[2] *Arboretum Notes*, 112 (1889).

### CULTIVATION

The Ilex or holm[1] oak as it was formerly called, was introduced into this country at a very early period, and was known to Clusius in 1581, who spoke of two trees then growing near London, one of which was old enough to bear acorns; and Evelyn[2] spoke of it as a tree which "thrives manifestly with us; witness his Majesty's privy garden at Whitehall, where once flourish'd a goodly tree of more than four-score years growth, and there was lately a sickly imp of it remaining. And now very many rais'd by me have thriv'd wonderfully, braving the most severe winters, planted either in standards or hedges, which they most beautifully become."

It ripens seed freely in the warmer parts of England, and reproduces itself where conditions are suitable; but pheasants are so fond of the acorns that few get a chance to grow; and they are better sown in a nursery or in pots, as the roots at first have very few fibres, and the tree, as Evelyn long ago remarked, is difficult to transplant. It is better to move them like hollies late in spring, or in August, if the autumn is moist and the climate mild. The Ilex undoubtedly likes sea air, and rarely grows as large inland as near the coast. It grows well on limestone, but also thrives in a good loamy soil, dry and well drained; and is sometimes killed by severe winters on wet and cold situations away from the coast.[3]

The tree varies extremely both in habit and foliage; and in a plantation at the Barton Farm, Osborne, I.W., where cork oaks and Ilex have been planted together, there are many seedlings which might be hybrids, though the bark of the older trees is always a good mark of distinction. In the Prince of Wales plantation, a little beyond the statue in Windsor park, I saw in 1909, a number of trees of very upright habit, which are said to have been planted in 1880, and are now in some cases over 40 ft. high.

### REMARKABLE TREES

Among the largest and finest trees in England are those at Mamhead, of which Bradley[4] wrote as follows: "That curious gentleman Robert Balle, Esq., F.R.S.,[5] has, among other improvements for the good of his country, propagated a large parcel of these trees in England, some of which have in about thirty years grown to a considerable greatness of stature. This gentleman has raised some thousands of them from acorns, and to follow his method we must set the acorns in loam well sifted, in garden pots in February, and turn them out with the earth about their roots when they are two years old." Ellis[1] a year later says that "at Mamhead in a shallow sort of soil of but 9 in. deep, before a red rock appears, these trees had prospered so well that at forty years' end the diameter of their bodies measured above a foot each, and the height of one of them was above 50 ft., with a straight taper stem without a knot." R. Pince[2] of the Exeter Nursery gave the dimensions of some of the trees at Mamhead in 1835 as follows:—

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[1] Murray, *Eng. Dict.* v. 343 (1901), states that *holm* is a phonetic corruption of *holn*, from *holen*, *hollin*, the Old English equivalents of the modern word holly. *Holm* is used by Chaucer in the *Knight's Tale*, meaning holly tree. *Holm* was apparently first used for the evergreen oak by Cooper, *Elyot's Dict.* (1552),—"Ilex, a tree called by some holme." Holland, *Pliny* i. 495 (1601), says: "There is an holme growing in the Vatican, elder than Rome it selfe." *Ilex*, however, is so generally used, that it may now be considered an English word.

[2] *Silva*, 171 (1706).

[3] In East Anglia, young trees twelve to twenty years old were killed in the severe winter of 1859-60; but old trees escaped with merely a browning of their leaves (cf. *Gard. Chron.*, 1869, p. 167). Many trees at Kew, but not all, were quite defoliated in the severe winter of 1908-9, when the temperature fell to 10° Fahr. on 30th December. Cf. *Kew Bull.*, 1909, p. 236.

[4] Bradley, *Improvements of Planting*, 38 (1739).

[5] In Polwhele's *History of Devonshire* (1793) it is said: "The woods and plantations of Mamhead were extensive; many of the trees were introduced by Mr. Thomas Ball, the last of that family (he died in 1749), who returning from the continent, brought with him a quantity of cork tree, Ilices, wainscot oaks (*Q. Cerris*), chestnuts, acacias, cedars, and other trees."

| | Height. | Girth. | |
|---|---|---|---|
| 1. *Quercus Suber* . | 60 ft. | 12½ ft. | |
| 2. " " . | 50 ft. | 11 ft. 3 in. | |
| 3. *Q. Ilex* . . . | 85 ft. | 11 ft. | One of a group on the confines of Haldon, about 600 ft. above sea-level. |
| 4. " . . . | 70 ft. | 14 ft. | Detached in middle of park. |
| 5. " . . . | 55 ft. | 22 ft. | In a sheltered place about 250 ft. |
| 6. *Q. Cerris hybrida*, Fulham oak | 80 ft. | 13½ ft. | About 500 ft. elevation. |
| 7. *Q. Cerris*, Turkey or wainscot oak | 100 ft. | 12 ft. | In a sheltered situation about 500 ft. elevation. |
| 8. " | 90 ft. | 15 ft. 3 in. | About 500 ft. elevation. |
| 9. " | 80 ft. | 14 ft. 1 in. | " exposed situation. |

Of these I cannot now identify Nos. 3 and 6. No. 4 is probably a fine old tree (Plate 326) near the big cork oak, and, in 1908, was 17 ft. 10 in. in girth. No. 5 is probably a very spreading tree with a short bole, near the gardens, which in 1908 measured[3] 21 ft. in girth. Besides these there is a group of very tall trees close to the Dawlish Lodge, which Sir R. Newman believes to be some of the earliest planted. The finest of these is at least 90 ft. high by 16½ ft. in girth.

At Tregothnan in Cornwall there are great numbers of this tree, which shade a beautiful drive along the shores of the harbour, but owing to the rocky soil do not attain any great size.

Perhaps the oldest-looking tree which I know of is at Wilton House, close to the mansion, and, though of no great height, its trunk measures no less than 18 ft. in girth, and its branches, which are supported by props, cover an area 90 paces round. Loudon states that in 1810 this tree was 10 ft. in girth.

At Frogmore, there is a large tree, having the leaves much larger than usual, and supposed to have been raised from Algerian acorns, though I can get no exact history of it. It measured about 50 ft. by 17 ft. in 1904; and another close by it with different leaves was 15½ ft. in girth.

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[1] Ellis, *The Timber Tree Improved* (1740).

[2] Loudon, *Gard. Mag.* xi. 127 (1835).

[3] The girth, 22 ft., recorded in 1835, may have been taken near the ground.

At Goodwood there are many fine trees in the grounds and in a belt north of the house. Here I measured in 1906 a tree 83 ft. by 7 ft. 7 in.

At Siston Court, Gloucestershire, there is a well-shaped and spreading tree which in 1908 was about 60 ft. by 17 ft. At Epping House, Hertford, Mr. H. Clinton Baker measured a tree 60 ft. by 16½ ft. in 1909.

At Godinton, near Ashford, the seat of G. Ashley Dodd, Esq., there is one of the finest that I have seen in England. This beautiful tree has a short bole 18 ft. 1 in. in girth, dividing into many large spreading branches which reach a height of about 75 ft., and spread over an area no less than 102 paces in circumference. It is a symmetrical tree, in perfect health, and must be considerably over 100 years old.

At Betteshanger, in the same county, Lord Northbourne showed me a tree of the same character, which measures about 50 ft. by 17 ft. at 3 ft. from the ground, and shows the suitability of this tree for a chalky soil, in the south-east of England.

At Cobham Park a beautifully shaped tree measured in 1905, 80 ft. by 15 ft., with a clean bole 20 ft. high. Lord Darnley thought it was surpassed by a tree at Faringford, Lord Tennyson's place in the Isle of Wight; but when I measured this in 1906, I found that, though it covered an area 94 paces round, its trunk, which consists of several stems fastened up by chains, was much inferior to the Cobham tree.

In Somersetshire, Sir C. T. D. Acland showed me a big Ilex at Holnicote, a stool with four trunks, about 70 ft. by 17 ft.

In the eastern counties near the coast this tree also thrives at many places, among which Holkham is pre-eminent for numbers and size. The Ilex seems to have been a very favourite tree with the late Earl of Leicester and his father, who planted in the park what is now the largest grove of evergreen oaks that I know. In this grove, known as the Obelisk Wood, I measured one in 1903, 75 ft. by 10½ ft., with a clean bole 28 ft. long; and another with a remarkable twisted trunk (Plate 324). A third tree on the outside of this grove, with wide-spreading branches, is shown in Plate 325. At Ken Hill near Snettisham, in Norfolk, the seat of Sir E. Green, there are two fine trees, the largest of which measures about 75 ft. by 19½ ft. at 2 ft. from the ground, dividing at 4 ft. into two main stems.

In Wales the finest I know of is a tree mentioned by Loudon at Stackpole Court, said to be 100 years old in 1838, and then 78 ft. high by 7½ ft. in girth. It is probably the same as one which in 1906 measured 80 ft. by 9 ft. 8 in, and though split to the ground, was kept together by a chain. The best Ilex now at Stackpole is a tree on the lawn measuring about 60 ft. by 14 ft. 5 in., whose trunk is curiously gnarled and distorted.

In Scotland the Ilex grows well on the south-west coast, especially in the Earl of Stair's grounds at Castle Kennedy, where there is a tree remarkable for its very weeping habit. This tree has five stems forking close to the ground, where it measures 12 ft. 8 in. in girth, and is about 47 ft. high. Another large tree is reported by Mr. Renwick to grow at Mount Stuart, in Bute, the seat of the Marquess of Bute, and to measure 10 ft. 5 in. in girth. At Fullerton House, near Troon, a tree is recorded by Paxton in *Remarkable Trees of Ayrshire*, 11 ft. 9 in. in girth.

As far north as Gordon Castle the Ilex is hardy near the coast; and I measured a tree there, which was 45 ft. by 10 ft. 10 in. in 1907.

Possibly the oldest if not the largest tree in Ireland, is one growing at Courtown on the Wexford coast, of which the Earl of Courtown has been good enough to send me a photograph. He believes that it may have been planted by Sir Walsingham Cook, whose mansion and garden were conveyed in 1648 to T. Jones, a sea-captain of Stepney: but in any case is a tree of very great age. In 1884 it was 66 ft. high, dividing into several large trunks close to the ground. At Rossanagh there is a very fine old tree 80 ft. high by 16 ft. 7 in. near the ground, dividing at 3 ft. into two big stems, one of which is 10 ft. 9 in., the other 8 ft. 8 in. in girth.

At Kilruddery Castle, Co. Wicklow, Henry measured two big trees in 1904, one 77 ft. by 14½ ft., the other 77 ft. by 11½ ft., with a bole about 25 ft. high. At Castlemartyr there are many fine old trees, one of which in 1908 measured nearly 100 ft. by 12 ft., with a bole of 30 ft. At Belgrove, near Queenstown, Mr. Gumbleton showed me a very handsome and well-shaped tree about 70 ft. by 14½ ft., the branches over 80 yds. round.

At Doneraile Court, Co. Cork, there is a tree with a short butt, 15 ft. 3 in. in girth, dividing into two main stems about 45 ft. high, with a spread of branches about 80 ft. across. At Cooper Hill, Limerick, Henry saw several very old trees of no great height, but of immense girth, one 21 ft., the other 18 ft., in 1907.

(H. J. E.)

## QUERCUS TURNERI, Turner's Oak

*Quercus Turneri*, Willdenow, *Enum. Hort. Berol.* 975 (1809), and *Berlin. Baumz.* 339, t. 3, fig. 2 (1811); Loudon, *Arb. et Frut. Brit.* iii. 1922 (1838).

*Quercus hispanica*, var. γ, *le chêne Turnère*, Lamarck, *Encyc. Méth.* i. 723 (1783).

*Quercus hybrida nana*, Loudon, *Arb. et Frut. Brit.* iii. 1924 (1838).

A tree, attaining about 50 ft. in height and 8 ft. in girth, variable in bark and foliage, probably hybrid in origin, the supposed parents[1] being *Q. pedunculata* and *Q. Ilex*. Two distinct forms occur, one with short broad leaves, corresponding to the typical plant described by Willdenow; the other with larger narrower leaves, treated by us as a variety. These two forms are connected by trees intermediate in foliage; and a seedling, about 5 ft. high, raised at Kew in 1894 from an acorn, produced by the narrow-leaved form, has both broad and narrow leaves.

The typical form is characterised as follows:—Young branchlets covered with dense stellate pubescence, glabrescent in the second year. Leaves slightly coriaceous, falling early in spring, before the new leaves appear, about 3 in. long and 2 in. wide, obovate, rounded or acute at the apex, rounded or slightly auricled at the base, with five to eight pairs of lateral nerves, all but the lowest one or two pairs ending in a sinuate tooth, with a cartilaginous tip, long and bristle-like in young plants, short and blunt in old trees; upper surface dark green, with deciduous scattered stellate hairs; lower surface pale green, with white stellate hairs on the midrib and nerves, elsewhere glabrous or with scattered inconspicuous pubescence; petiole ¼ in. long, densely pubescent.

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[1] The fruit on long peduncles, and the auricles often present at the base of the leaf indicate *Q. pedunculata* parentage. The subevergreen habit, the pubescence on the branchlets and leaves, and the mucronate teeth of the latter, suggest the influence of *Q. Ilex*. The bark usually resembles that of *Q. Ilex* more than the common oak.

Fruit ripening in the first year, three to seven, of which only one or two develop, sessile on a slender tomentose peduncle, about 2 in. long; acorn ovoid, about ¾ in. long, with appressed long white hairs towards the apex, which is crowned by the conspicuous tomentose style; cupule about ½ in. in diameter, urceolate, covered with closely appressed grey tomentose ovate scales, reddish at the tips, and diminishing in size from the base to the constricted thin margin of the cupule.

Var. *pseudoturneri.*

*Quercus glandulifera*, Masters, in *Gard. Chron.* xiv. 714, fig. 134 (1880) (not Blume).
*Quercus pseudoturneri*, Schneider, *Laubholzkunde*, i. 200, fig. 126 *g, h* (1904).
*Quercus aizoon*, Koehne, in *Gartenflora*, liii. 657 (1904).

Usually a smaller tree than the typical form. Leaves (Plate 337, Fig. 45) usually longer and narrower, averaging 4 to 5 in. long and 1½ to 2 in. wide; teeth larger, with mucronate points often obsolete; under surface more pubescent than in the type; base rounded, auricled, or cuneate.

The earliest account of this oak is by Lamarck, who described it in 1783, from a specimen growing in the garden of the Trianon, as *le chêne Turnère*, said to have been found originally as a seedling in England, which was propagated by grafting. Messrs. Loddiges informed Loudon that it was a hybrid, "raised about 1795 or before, by Mr. Spencer Turner, in the Holloway Down Nursery, Essex, which was founded by him about 1787." The latter account is evidently inaccurate as regards dates; but it may be assumed that the oak was raised by Mr. Turner sometime before 1783, when it was well-known to Lamarck. Willdenow[1] founded his description on a plant of the broad-leaved form, growing at Berlin, which had been sent to him by Loddiges. The narrow-leaved variety appears to have been the form more generally propagated, especially by Rivers at the Sawbridgeworth Nursery, where Loudon states that there was a tree forty years old in 1838. It is possible that both forms of foliage occurred on the original tree in Turner's nursery.

In the Bristol Nursery, a tree was found in 1825 in a bed of seedling oaks, which Loudon describes as *Q. hybrida nana*, and this seems to have been a form of *Q. Turneri*, bearing both broad and narrow leaves. It is said by Loudon to have been a bush rather than a tree; but the original plant made fairly rapid growth, having attained 9 ft. high in twelve years. This was propagated by Messrs. Loddiges, and may be the origin of some of the trees now in cultivation.

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[1] Willdenow's statement that the tree came originally from Tibet is evidently due to a confusion between Spencer Turner, the nurseryman, and Samuel Turner, the famous traveller, who visited Tibet about 1786.

(A. H.)

### Remarkable Trees

Of the typical form, we have identified the following, but it is probable that other trees exist which we have overlooked.

A tree at Ham Manor, Sussex, forking near the ground, and carrying its leaves until after mid-winter. In 1907 it was about 45 ft. high.

A tree at Nuneham Park, with bark like that of the common oak on which it is grafted, measured by Henry in 1907, 48 ft. by 4 ft. 4 in. A tree in the Wilderness at White Knights, grafted on the common oak and not showing much of the Ilex character in the bark, measured by me in 1907, when it was 52 ft. by 6 ft. 10 in. above the graft. At Bayfordbury a tree said to have been planted in 1837 with Ilex-like bark, 40 ft. by 3 ft. At Henham Hall, Sussex, a tree 50 ft. by 8 ft. At Lyndon, a tree 53 ft. by 6 ft. grafted near the ground on the common oak and showing no trace of the Ilex parentage in the bark.

A small tree in the Royal Botanic Garden, Edinburgh, is the only one we have seen in Scotland; but Mr. Bean mentions one 45 ft. high in 1906, which he saw at Kinfauns Castle, Perthshire.

In Ireland there is a tree at Oriel Temple with typical Ilex-like bark, which in 1908 was 48 ft. by 4 ft. with a bole about 20 ft. high.

Of the *pseudoturneri* form the best specimen we know of is at Syon, a tree 62 ft. by 4 ft. 4 in., having a clean bole of considerable height injured on one side. At Kew there are several trees of which the largest measures 37 ft. by 5 ft. Their history is unknown and they were unnamed before 1880. In the Sawbridgeworth Nursery there are two trees believed to have been propagated from the original tree by grafting on the common oak. The larger of these measured in 1908 about 50 ft. by 5 ft., and on June 4th had a good many of the previous year's leaves still on it. The other tree, growing in a beech hedge, is much more stunted, and had no old leaves left on it, but was flowering profusely. We have specimens of this form from trees growing at Eastnor Castle; from Alnwick sent by Miss Manders; and from Monreith. I also found a tree at Castlewellan in Ireland.

Judging from all that we know, this hybrid does not seem to have anything to recommend it as an ornamental tree, and is much inferior in size and beauty to the Lucombe oak.

(H. J. E.)

## QUERCUS AUDLEYENSIS

*Quercus Ilex* × *Q. sessiliflora* (?)

At Audley End, Essex, there is a remarkable oak, which we have been unable to identify with any described species, and which is probably a hybrid between the evergreen oak and *Q. sessiliflora.* It is characterised as follows:—

Young branchlets slender, grey tomentose, the tomentum being retained in the second year. Buds $\frac{1}{5}$ to $\frac{1}{4}$ in., ovoid, obtuse, few-scaled, pubescent. Stipules persistent, linear, pilose, $\frac{1}{2}$ in. long, two at the base of each leaf. Leaves (Plate 338, Fig. 59) slightly coriaceous, falling late in the season, up to $3\frac{1}{2}$ in. long and 2 in. broad, very variable in shape on the same branch, narrow elliptical and entire or slightly undulate in margin, or obovate to obovate-oblong with 4 to 5 pairs of sinuate teeth or small lobes in the upper two-thirds, occasionally with one to three teeth near the apex; teeth with or without a minute projecting mucro; nerves five to eight pairs, ending in the teeth or dividing before reaching the margin when it is entire; apex rounded; base unequal, rounded or cuneate; both surfaces stellate pubescent when young, upper surface, when mature, dark green, shining, glabrous; lower surface pale green, retaining the pubescence on the midrib and basal part of the blade; petiole $\frac{1}{2}$ to $\frac{3}{4}$ in. long, with scattered stellate tomentum.

Fruit, imperfect, probably never developing, in pairs at the apex of a short erect tomentose axillary peduncle.

In favour of this oak being a hybrid, may be noticed the instability of form of the leaves on the same branch; some resemble the entire leaves of *Q. Ilex*; others are like the obovate lobed leaves of *Q. sessiliflora.* It agrees with both species in the nervation. The slender tomentose branchlets, minute mucros of the teeth, and the persistent stipules are like *Q. Ilex*, from which it may derive its subevergreen habit.

It resembles superficially some of the forms of *Q. lusitanica* in Portugal, but these have uniform leaves on the same branchlet and are different in venation.

This beautiful oak, the origin of which is unknown,[1] has bark somewhat resembling that of *Q. Ilex*, and measured in 1908, 86 ft. in height and 11 ft. 3 in. in girth (Plate 327). It was reported never to bear fruit; but a few imperfect acorns were formed in 1909. (A. H.)

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[1] Lord Braybrooke informs us that in a catalogue of trees at Audley End, made in 1834, he finds "Lucombe's Oak" mentioned; and as I saw no tree of that species, it is probable that it is the same as the one now described.

## QUERCUS SUBER, Cork Oak

*Quercus Suber*, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1911 (1838); Willkomm, *Forstliche Flora*, 424 (1887); Coutinho, in *Bull. Soc. Brot.* vi. 82 (1888); Mathieu, *Flore Forestière*, 377 (1897).

*Quercus suberosa*, Salisbury, *Prod.* 392 (1796).

*Quercus Bivoniana*, Gussone, *Fl. Sicul. Syn.* ii. 604 (1844).

A tree, attaining 60 ft. in height and 20 ft. in girth, usually much smaller. Bark thick and corky, occasionally becoming a foot in thickness on old trunks, which are deeply fissured. Young branchlets covered with a dense greyish tomentum, retained in the second year. Leaves (Plate 339, Fig. 63) coriaceous, persistent two or three years, often convex above and concave beneath, about 2 in. long and 1¼ in. wide, variable in shape, ovate or oval, acute or rounded at the apex, unequal at the base; with about six pairs of lateral nerves, all but the lowest one or two pairs, ending in a minute mucronate tooth; upper surface bright green, glabrescent; lower surface covered with a dense grey tomentum; petiole, ¼ to ½ in. long, tomentose.

Fruit in the typical form, ripening in the first year, solitary or in pairs on short stout grey tomentose axillary peduncles; acorn ¾ to 1 in. long, variable in shape, glabrous, with a tomentose apical umbo; cupule turbinate, ½ to ¾ in. in diameter at the rim, covered with grey tomentose scales, reddish at the tips, ovate and short in the basal ranks, long linear and mostly erect in the upper half of the cupule.

Var. *occidentalis*.

*Quercus occidentalis*, Gay, in *Ann. Sc. Nat.* vi. 243 (1856), and in *Bull. Soc. Bot. France*, iv. 449 (1857); Mathieu, *Flore Forestière*, 384 (1897).

Leaves deciduous in June of the following year, when the next season's leaves are already developed. Fruit ripening in the second year; cupules hemispherical, with appressed ovate obtuse grey tomentose scales, red at their tips.

This variety is the only form of the cork oak in the south-west of France, and is also found on the coast of Portugal, where according to Coutinho,[1] the distinction between it and the type disappears, acorns of both kinds being found on the same tree. There the cork oaks flower continuously from January to April. The acorns produced by the first flowers either ripen in September or in October and November, two distinct crops being noticeable. The acorns produced by the last flowers of the season are stopped in their growth by the winter cold, and ripen in the following year, constituting a third crop. The latter, according to Coutinho, have cupules with scales similar to those of *Q. occidentalis* in the Landes.

This variety is, however, considerably hardier than the type, as plantations made in Brittany in 1826 with acorns from the Landes succeeded, while those made with acorns from Catalonia soon perished. At Nancy, var. *occidentalis* resists the cold of ordinary winters, while the typical form always succumbs in the first winter after planting.

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[1] Daveau, who had much experience in Portugal as well as in Provence, in a pamphlet, *Note sur le Q. occidentalis*, ex *Ann. Soc. Hort. Hérault* (Montpellier, 1899), confirms the opinions of Coutinho.

### Distribution

The cork oak is a native of the Mediterranean region, exclusive of the Levant, and occurs in France, Spain, Portugal, Corsica, Sardinia, Italy, Sicily, Istria, Dalmatia, and Albania; and in northern Africa, in Morocco, Algeria, and Tunis. It is usually found growing wild on granitic or slate soils, and is never seen on limestone formations, where it is replaced by *Q. Ilex.* It usually either forms pure and rather open woods, or is mixed with other oaks; but on sandy soil near the sea-coast is often found scattered in the forests of maritime pine.

In France there are three regions where it flourishes and is of commercial importance: in the Landes and in Lot-et-Garonne; in the Pyrénées Orientales, where it ascends to 1600 ft.; and along the Mediterranean coast from Toulon to Antibes, where it is confined to non-calcareous soils. In Corsica, though large woods are rare, it is widely spread and covers an estimated total area of 18,000 hectares. In Sardinia, nearly all the important woods, which were formerly very fine and of large extent, have been destroyed, except those in the valley of Tempio, where there are fine trees producing an excellent cork. The cork tree is of no great importance on the mainland of Italy, though widely distributed on the western coast; but in Sicily there are extensive forests, often composed of large trees, the most notable between Caltagirone and Terranova having an area of 40,000 hectares.

In Algeria, the principal forests where this species is met with are in the mountainous region close to the sea, from Dellys eastward to the Tunisian frontier, where the annual rainfall exceeds 24 in. Here three species of oak occur, often mixed; but as a rule *Q. Suber* and *Q. Mirbeckii* occupy northern aspects, the former growing on the slopes and crests of the mountains, and the latter in the better soil in the ravines; while *Q. castaneæfolia* is restricted to southern slopes. In Oran and the western part of the province of Algiers, the oak woods are small in extent, and are mainly composed of *Q. Suber*, *Q. Ilex*, and *Q. coccifera.* The total area covered by the cork oak in Algeria is estimated at 426,000 hectares; and the annual production of cork, steadily increasing, amounted in 1899 to about 16,000 tons.

In Tunis, the forests of this species occur in the north-east in the Khroumir mountains, and cover about 82,000 hectares, with an annual production of cork of 1200 to 1500 tons. In Morocco, there are large forests in the Riff mountains between Tetuan and Melilla; and scattered smaller woods are reported in the interior, as far south as Morocco and Agadir; but up to the present these have not been utilised, except in a trifling way.

In Spain, where the woods of *Q. Suber* are estimated to cover an area of 300,000 hectares, the most important are in Catalonia, in the hills close to the sea-coast, where this species is associated with *Pinus Pinea* and *Pinus Pinaster.* There are also extensive forests in Estremadura, and many scattered woods throughout Andalusia.

The Catalonian forests furnish the best quality of cork, that used for champagne bottles; and it was here that about 150 years ago, at San Lorenzo de la Muga, the trees were first artificially treated, so as to produce a better quality of cork than the natural bark affords. Throughout Spain, the forests are poorly treated; natural regeneration is rendered nearly impossible by grazing animals, and artificial plantations are unknown. (A. H.)

In Portugal, where, according to Lefebvre, the largest amount of cork is produced, the forests are well cared for, and many new plantations are made. In central and southern Portugal the cork oak is one of the commonest and most widely cultivated trees, principally on account of the value of its bark, but also for its acorns. It is usually planted on the drier lands which are ploughed for wheat at intervals of two or three years, and are grazed by sheep and pigs at other times.

In the better cultivated districts it is barked at intervals of eight to ten years, and from about twenty-five to thirty years up to a hundred and fifty or more, when the quality of the cork begins to decline. The bark is taken off the trunk and lower branches down to about 6 in. in diameter, and the trees so treated have a very different appearance to wild or unbarked trees, being comparatively smooth and reddish brown in colour. In the woods near Cintra, on Sir Frederick Cook's property, there are many large and very picturesque trees, which are never barked, and have wide-spreading branches, but they do not here attain anything like the size that they do farther inland, where the soil is stronger and the climate drier.

On the property of Senhor Suares Mendes, near Abrantes, where the lower parts of the valleys running back into the plateau were full of splendid cork oaks, I measured a magnificent tree nearly 60 ft. high, with a trunk about 12 ft. in girth, dividing at about 12 ft. into twenty large branches, which covered an area 25 paces in diameter. Another, which some years previously had been severely lopped, was about 25 ft. in girth, and though of great age seemed to be perfectly sound. In this valley, which reminded me somewhat of the foothills in San Bernardino county, California, the cork trees were scattered at irregular intervals, as though self-sown, and gave the effect of old oaks in an English park. Their produce is very valuable, and I was told by Mr. Percy Ellis of Lisbon, who has a large cork factory, that there was much difference in the quality in different parts of the country, but that the cork of Alemtejo was perhaps equal, if not superior to any in the world. Specimens of the different qualities showing the injuries produced by various causes, which he was good enough to give me, are now in the Cambridge Forestry Museum.

I heard of still larger trees than those which I have mentioned; one between Niza and Povoa de Meadas, in Alemtejo, supposed to be 300 years old and growing on granite soil, which seems to suit this tree best, was 18 metres high by 7·20 metres in girth, the diameter of the crown 28 metres; another at St. Anna de Malto in the commune of Concho, 5 metres in girth, produced in 1879, 1465 kilos, and in 1889, 1755 kilos (nearly two tons) of cork. A third, near the Chapel of San Gonçalo, on the road to Palonella, 10 miles south of Lisbon, of which a photograph is given in *Bull. Soc. Tosc. d'Hort.* ser. ii. vol. ii. p. 19 (1887), was 18 m. high by 9 m. in girth, with bark 20 cm. thick, and supposed to be 400 years old. This tree has produced as much as 800 litres of acorns in one year. The cork tree is known in Portugal as *sobreiro*, and in Spain as *alcornoque* or *suro* in Catalonia, and *sobreiro* in Galicia.

I did not see or hear of any cork trees either in the south-west of France, or on the Riviera, which approached the dimensions above given. In the Esterel mountains between Cannes and Frejus, where it is abundant, the trees rarely exceed about 50 ft. in height and 10 ft. in girth. There is a large cork tree in the Botanic Garden at Florence, believed to have been planted in 1805. When I saw it in February 1910, it measured 80 ft. by 10½ ft., with a clean trunk about 20 ft. high, and a well-shaped spreading crown.

### CULTIVATION

I am informed by M. Marc Bazille of Montpellier that all the attempts which have been made in the south of France to graft the cork oak upon the Ilex, with the object of extending its cultivation to the calcareous soils of Provence, have failed, and this is confirmed by Prof. Flahault.

The cork oak is said[1] to have been introduced in 1699 by the Duchess of Beaufort; but the present Duchess, who has been good enough to search the archives at Badminton, was not able to find anything relating to the introduction. Judging from the age of many existing trees it must have become fairly common early in the eighteenth century. It seems to have been usually grown from acorns, which are commonly produced in the warmer parts of the south of England and usually ripen in the second season.[2] Though it has in one place reproduced itself naturally, it is best to sow the acorns in pots or in a frame, as the seedlings require protection for two or three years at least.

In England the largest[3] is the splendid tree at Mamhead Park near Exeter, the seat of Sir R. Newman, Bart., which is now about 60 ft. by 15 ft. 2 in. in girth (Plate 328). This noble specimen grows on red loam at an elevation of at least 400 ft., and is exposed on all sides. A second tree about 50 ft. by 11½ ft. grows near it. At Haldon House, near Exeter, there is a tree only second in size to the one at Mamhead, and even more perfect in shape. In 1908 it was 60 ft. by 9 ft. 4 in., and looked very healthy. At Sidmouth Miss Woolward has photographed a tree over 60 ft. high and 9 ft. 4 in. in girth; and at Powderham, Killerton, and other places in south Devonshire, there are trees nearly as large. At Tregothnan, Mr. A. B. Jackson measured a tree 58 ft. by 9 ft. in 1908.

At Sherborne Castle, Dorset, there is a tree in the walk, east of the old castle, which has been rather drawn up by other trees, and in 1909 was 59 ft. by 8 ft. 2 in. At Claremont there is another which is fast decaying, and of no great height, whose trunk measured in 1903 no less than 16 ft. in girth.

At Pains Hill, in Surrey, there is a fair-sized tree which has reproduced itself naturally from seed, and healthy seedlings were growing in the grass near it in 1903.

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[1] Aiton, *Hort. Kew.* v. 289 (1813).

[2] Judging from the few specimens, which we have seen, with ripe fruit.

[3] Cf. p. 1286.

But in the midland and northern counties the tree seems to suffer so much from exceptionally severe frosts and lack of summer heat, that we know of no good trees.

In the east of England the cork tree is also quite hardy, and at Linton Park, Kent, there is a fine tree, planted by Sir Horace Mann in 1778, which is 50 ft. by 9 ft. At Orwell Park, Suffolk, on the lawn, exposed to the east wind from the North Sea, there is a tree about 40 ft. by 8 ft. whose leaves were only just appearing on 23rd June 1905 when most of the old leaves had fallen. At Henham Hall, Suffolk, the seat of the Earl of Stradbroke, there is a healthy cork tree close to the house, which in 1909 measured about 40 ft. by 11 ft., and sometimes produces ripe acorns.

At Stout Hall, in Glamorganshire, Mrs. Nicholl tells me of a tree which is considered to be the largest in Wales, and which is 50 ft. high by 13 ft. near the ground, where it forks into five or six main stems.

In Scotland the only tree we have on record is one at Mount Stuart, Bute, which, when measured in 1903 by Mr. A. Renwick, was about 20 ft. by 3 ft. 10 in., with a bole 10 ft. high.

In Ireland the only tree we know of large size is one at St. Joseph's Cemetery, near Cork, which Henry measured in 1903, when it was about 50 ft. high, with a short trunk dividing into four stems which measured from 4½ to 6 ft. in girth. The tree at Summerstown, near Cork, figured by Loudon, and said to be 30 ft. by 8 ft. 10 in. below the fork in 1828, has been dead for some years, although, when recently seen by Mr. R. A. Phillips, 6 ft. of the trunk, with the bark quite sound but the timber rotten, was still lying on the ground.

### TIMBER. CORK

The timber of the cork tree seems to be little used except for firewood, and to some extent by wheelwrights in Portugal, probably because it is rarely cut until the tree is worn out and partly decayed, and I could not learn that it is ever exported. According to Mathieu, the wood is similar to that of *Q. Ilex*, but is not so homogeneous or fine in the grain, but is equally heavy and hard. A board which was sent me from a tree which died at Blaize Castle, showed very handsome grain when quartered, but the heartwood was discoloured.

The cork naturally produced, what is called in French natural, male, or virgin cork, is of little value on account of its hardness and brittleness, but is taken off the trees when young, which then begin to produce the cork of commerce called female or reproduced cork. This increases in thickness fastest between the second and sixth year, and is usually taken off after eight to ten years, the quality improving with the age of the tree, which may continue to produce marketable cork for 150 to 200 years or even more. When taken off, the slabs are scorched over a fire and pressed to flatten them.

Many details with regard to the commercial production and preparation of cork[1] are given at length by Loudon and other authors, but as the subject has no economic importance to British arboriculturists, we omit them. (H. J. E.)

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[1] The best and latest account of the cork tree, with complete statistics of the production, export, and imports of cork throughout the world, is given by Lefebvre, *Forêts de l'Algérie*, pp. 135-326 (1900). Another monograph on the cork oak in its commercial aspect by E. A. Müller, published in *Abh. k.k. Geogr. Ges. Vienna*, 1900, may also be consulted.

## QUERCUS SEMECARPIFOLIA

*Quercus semecarpifolia*, Smith, in Rees, *Cyclop.* xxix. No. 20 (1819); Hooker, *Fl. Brit. India*, v. 601 (1888); Skan, in *Journ. Linn. Soc.* (*Bot.*) xxvi. 520 (1899); Gamble, *Man. Indian Timbers*, 671 (1902); Brandis, *Indian Trees*, 625 (1906).
*Quercus obtusifolia*, Don, *Prod. Fl. Nepal.* 56 (1825).
*Quercus Cassura*, Don, *Prod. Fl. Nepal.* 57 (1825).

A tree, occasionally attaining in the Himalayas 100 ft. in height and 18 ft. in girth, usually considerably smaller. Young branchlets with scattered stellate pubescence. Leaves (Plate 338, Fig. 53) coriaceous, subevergreen, falling a month or two before the new leaves appear, very variable in size and margin; averaging 3 in. long and 2 in. broad; usually elliptical; rounded or rarely acute at the apex; cordate or rarely rounded at the base; margin on old trees undulate-entire, on young trees with spine-tipped serrations or teeth; lateral nerves six to ten pairs, forking before reaching the margin; upper surface dark green, with scattered stellate pubescence, retained on the midrib, soon deciduous elsewhere; lower surface pale, with scattered fine stellate pubescence; petiole $\frac{1}{16}$ to $\frac{1}{2}$ in., stellate-pubescent.

Fruit ripening in the second year, solitary or in pairs, on a short stout pubescent peduncle; acorns globose or ovoid, enclosed at the base in a hemispherical cupule, about $\frac{1}{2}$ in. in diameter, and covered with closely appressed tomentose scales.

This species, which has holly-like leaves, is readily distinguished from *Q. Ilex* by the subevergreen leaves, which have lateral veins always forked before reaching the margin.

It is a native of the Himalayas from Kumaon to Bhutan and Munnipore, occurring at altitudes of 6000 to 12,000 ft.; and also occurs in the mountains of China, in the provinces of Szechwan and Yunnan. Though mentioned by Loudon[1] as one of the Himalayan oaks worthy of a trial in this country, it appears not to have been introduced till lately. Mr. Gamble has raised two plants from acorns received in 1900 from Chakrata in the north-west Himalaya at 9000 ft. These have thriven in his garden at East Liss, Hants, and seem perfectly hardy, their present height being 10 ft. and 15 ft. (A. H.)

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[1] *Arb. et Frut. Brit.* iii. 1935 (1838).

## QUERCUS INCANA

*Quercus incana*, Roxburgh, *Hort. Bengal*, 104 (1813), and *Fl. India*, iii. 642 (1832); Hooker, *Fl. Br. India*, v. 603 (1888); Gamble, *Man. Indian Timbers*, 675 (1902); Brandis, *Indian Trees*, 626 (1906).

*Quercus dealbata*, Wallich, *List*, 2769 (1828-49).

*Quercus lanata*, Don, var. *incana*, Wenzig, in *Jahrb. bot. Gart. Berl.* iv. pt. i. 222 (1886).

A tree, attaining 80 ft. in height and 12 ft. in girth. Young branchlets white tomentose. Leaves (Plate 335, Fig. 18) coriaceous, persistent two years, 3 to 6 in. long, 1 to 2 in. wide, elliptic-lanceolate, acuminate at the apex, rounded or tapering at the base; with ten to fifteen pairs of lateral nerves, all but the lowest one to three pairs ending in a mucronate triangular serration; upper surface glabrous; lower surface densely covered with white tomentum; petiole ¼ to ½ in. long, white tomentose.

Fruit ripening in the second year, solitary or clustered on very short tomentose stalks; acorn ovoid-conic, about an inch long, tomentose with a short cylindrical umbo, enclosed for half its length in a hemispherical cupule, ½ in. in diameter, covered with closely appressed tomentose triangular scales.

This species is a native of the north-western Himalayas at altitudes between 4000 and 8000 ft.

The only specimen we have seen in cultivation is growing in the temperate house at Kew. Mr. Gamble has young plants at East Liss, Hants, which are kept alive with difficulty out-of-doors in winter. This oak has not, however, been tried in the south-west of England or in Ireland, where it would probably be hardy and worth cultivating on account of its handsome foliage. (A. H.)

## QUERCUS PHILLYRÆOIDES

*Quercus phillyræoides*, A. Gray, in *Mem. Amer. Acad.* vi. 406 (1859); Masters, in *Gard. Chron.* i. 632 (1874); Franchet et Savatier, *Enum. Pl. Jap.* i. 446 (1875); Shirasawa, *Icon. Ess. Forest. Japon*, text 58, t. 31, figs. 1-12 (1900).

*Quercus Ilex*, Linnæus, var. *phillyræoides*, Franchet, in *Journ. de Bot.*, 1899, p. 152; Skan, in *Journ. Linn. Soc.* (*Bot.*) xxvi. 516 (1899).

A small tree, 20 to 30 ft. high, or a large shrub. Young branchlets densely covered with minute stellate pubescence, retained in part in the second year. Leaves (Plate 339, Fig. 66) coriaceous, persistent two years, 1½ to 2 in. long, ¾ to 1 in. broad, oval or obovate-oblong, rounded or acute at the apex, rounded or sub-cordate at the base; lateral nerves inconspicuous, about eight pairs, dividing and looping before reaching the margin; occasionally entire, but usually with four or five pairs of serrations in the apical half of the blade; upper surface dark green, stellate-pubescent on the midrib, elsewhere glabrescent; lower surface light green, glabrous except for dense pubescence on the base of the midrib, continuous with that on the very short stout petiole.

Fruit ripening in the second year, sub-sessile; cupule hemispherical, about ⅜ in. in diameter, tomentose within, and covered externally with whitish tomentose closely appressed scales, dark red at the tips; acorn, ½ to ¾ in. long, tomentose towards the apex.

This species is a native of Japan, where it was discovered near Simoda; and in recent years has been found in the high mountains of western China in the provinces of Szechwan and Yunnan.

In Kew Gardens, the only place where we have seen this species, it forms an elegant shrub, with dense bright green foliage, and is perfectly hardy. The oldest specimen, which has not yet produced acorns, is about 15 ft. high, and was introduced by Oldham, who made collections in Japan in 1861 and 1862. Smaller specimens, 2 to 6 ft. high, have been obtained since from Japan. (A. H.)

## QUERCUS CHRYSOLEPIS

*Quercus chrysolepis*, Liebmann, in *Overs. Dansk. Vidensk. Selsk. Forhandl.* 173 (1854); Sargent, *Silva N. Amer.* viii. 105, tt. 398, 399 (1895), and *Trees N. Amer.* 257 (1905).
*Quercus fulvescens*, Kellogg, in *Proc. Calif. Acad.* i. 67 (1855).
*Quercus crassipocula*, Torrey, in *Pacific R. R. Rep.* iv. 1, p. 137 (1856).

A tree, occasionally attaining 50 ft. in height and 15 ft. in girth, with wide-spreading branches; often shrubby. Bark covered with small appressed scales. Young branchlets with scattered stellate pubescence. Leaves (Plate 338, Fig. 61) coriaceous, persistent three years, very variable in size and shape, often entire on old trees; on young trees, oblong ovate, about 2 in. long and 1¼ in. wide, acute and spine-tipped at the apex, broad and usually cordate at the base; margin with twelve to twenty spiny triangular small teeth; upper surface dark green with minute stellate pubescence; lower surface more or less covered with yellow appressed hairs and dotted with minute shining glands; petiole, ⅛ in. long, pubescent, glandular.

Fruit ripening in the second year, solitary, sessile or sub-sessile; acorn ovoid, variable in length, slightly pubescent at the apex, enclosed at the base in a thick turbinate cupule, covered with triangular scales, hoary at their short free tips, or hidden in a dense yellow tomentum.

This species is extraordinarily variable both in foliage and fruit; and is most readily recognised by the glands on the lower surface of the leaf.

In var. *vaccinifolia*, Engelmann, in *Trans. St. Louis Acad.* iii. 393 (1878), a low prostrate shrub, growing on sub-alpine slopes, the leaves are usually oval and entire, and scarcely exceed an inch in length.

This species is more widely distributed than *Q. agrifolia* and *Q. Wislizeni*, the other Californian evergreen oaks with spiny leaves; as it extends northwards into southern Oregon, southwards to Mt. San Pedro Martir in Lower California, and eastward to the high mountains of southern Arizona, New Mexico, and the province of Sonora in Mexico. It yields valuable wood, which is used in the manufacture of waggons and agricultural implements.

The only specimens which we have seen in cultivation are plants at Kew, 2 to 3 ft. high, raised from acorns obtained from Meehan in 1904. There are also small plants at Coombe Wood. (A. H.)

## QUERCUS GLABRESCENS

*Quercus glabrescens*, Bentham, *Pl. Hartw.* 56, 348 (excl. syn. *Q. splendens*, Née) (1839); De Candolle, *Prod.* xvi. 2, p. 34 (1864); Liebmann, *Chênes Am. Trop.* t. 39 (1868); Hemsley, *Biol. Centrali-Amer. Bot.* iii. 172 (1882).

A small tree. Bark peeling off in thin quadrangular scales. Young branchlets slender, with scattered stellate pubescence. Buds minute, globose, surrounded by persistent linear pubescent stipules. Leaves (Plate 339, Fig. 67) coriaceous, persistent two years, 2 to 2½ in. long, ¾ to 1 in. broad, obovate-oblong, rounded or sub-cordate at the base, acute at the apex; margin thickened, revolute, with three to six pairs of gland-tipped small teeth above the middle; lateral nerves seven or eight pairs ending in the margin; upper surface dark green, shining, pubescent on the midrib, elsewhere glabrescent; lower surface yellowish, with scattered stellate pubescence; petiole stout, ¼ in. long, stellate-pubescent.

Fruit ripening in the first year, two or three on a pubescent peduncle; acorn ovoid, surrounded in its lower half by a hemispherical cupule, covered with appressed ovate pubescent scales.

This species is a native of the mountains of southern Mexico, and was first described by Bentham, from specimens collected by Hartweg, the locality being unknown, but supposed to be near Real del Monte. Liebmann afterwards, in 1841 and 1842, found it growing on the peak of Orizaba at 8000 to 9000 ft. altitude, and also at Chinantla, Cuesta de Lachopa, and Cerra Leon. It appears to be a small evergreen tree, but its dimensions are not stated. Amongst Liebmann's specimens at Copenhagen, there is an entire-leaved variety of this species, which I have not seen.

This appears to have been one of the trees introduced by Hartweg, who sent all his specimens of oaks, with acorns of some of the species, to the Horticultural Society; but Gordon,[1] in his account of the new plants introduced into the Chiswick Garden in 1840, states that the acorns of this species were presented by Mr. Strangways.

The only tree which survives, so far as we know, is growing in the Botanic

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[1] In Loudon, *Gard. Mag.* xvi. 636 (1840). Cf. Loudon, *Trees and Shrubs*, 904 (1842).

Garden of Trinity College, Dublin, and is now about 25 ft. high, with a bole 9½ ft. in height and 2 ft. 5 in. in girth. Mr. S. G. Wild reports that it is healthy and vigorous, and not affected by the winter's cold. It produced acorns in 1905, which apparently did not ripen. (A. H.)

## QUERCUS ALBA, White Oak

*Quercus alba*, Linnæus, *Sp. Pl.* 996 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1864 (1838); Sargent, *Silva N. Amer.* viii. 16, tt. 356, 357, 358 (1895), and *Trees N. Amer.* 259 (1905).

A tree, attaining in America 150 ft. in height and 18 ft. in girth. Bark grey, on young trees broken into long thin loose irregular scales; on old trunks about 2 in. thick, and divided into broad flat scaly ridges. Young branchlets glabrous, shining. Buds ovoid, obtuse, reddish brown, ⅛ in. long. Leaves (Plate 336, Fig. 33) deciduous in winter, turning reddish before they fall, occasionally withering and persistent during winter, about 7 in. long and 4 in. broad, obovate, cuneate at the base, obtuse at the apex, with seven to nine lobes; terminal lobe truncate, sinuate, or with three lobules, of which the two lateral are unequal in size; lateral lobes oblong, usually entire, variable in width and depth; lateral nerves ending in some of the sinuses as well as in the lobes; upper surface dark green, glabrous; lower surface pale, covered with a very minute pubescence, only discernible with a strong lens, no conspicuous hairs being present on the midrib or nerves; petiole ½ in. long, glabrous.

Fruit ripening in the first year, sessile or on a slender stalk, both forms sometimes occurring on the same branch, single or in pairs; acorn edible, ovoid, rounded at the apex, shining, ¾ in. long, enclosed for one-quarter of its length in a hemispherical cupule, which is covered with tomentose scales thickened and tuberculate in the lower ranks, thin and membranous towards the rim. Individual trees, believed to be hybrids[1] of *Q. alba* with other oaks, have been observed in different parts of North America, the most noteworthy being that with *Q. macrocarpa*. See p. 1304.

The White Oak has a wide distribution, extending northward to lat. 46° in southern New Brunswick, south-western Quebec, and southern Ontario; westward through southern Michigan and Wisconsin to southern Minnesota, south-eastern Nebraska, and eastern Kansas; and southward to northern Florida and the Gulf States as far as the Brazos river in Texas. It is one of the most common oaks of the Mississippi basin and of the Atlantic states, growing both on fertile uplands and on alluvial soil, which is not too moist. It is abundant and of large size in Ontario and the northern borders of the United States, furnishing the "Canadian oak" exported to England, which is now supplemented by large supplies from Ohio and Indiana, and even from Kentucky and west Virginia, by way of the Great Lakes. The tree is most abundant and of its largest size in the alluvial lands of the lower Ohio basin, in the Carolinas, and on the western slopes of the Alleghanies in Tennessee, rarely ascending above 2000 ft. in the extreme south.

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[1] These are described and figured by Sargent, *Silva N. Amer.* viii. 18, tt. 359, 360, 361 (1895).

Prof. Mohr states that in the forests where the white oak originally formed one-fourth to one-half of the timber growth, it is associated with black and Spanish oaks, hickories, beech, black walnut, and tulip tree; towards the north and at high levels in the south, its companions are red oak, scarlet oak, and chestnut; and in the extreme south it is mixed with the Carolina hickory, *Q. Phellos*, *Q. Schneckii*, and *Magnolia acuminata*. The undergrowth is mostly *Cornus*, *Ostrya*, *Carpinus*, *Amelanchier*, and *Cercis*. Where the original forest has been cut down, white oak is scarcely seen in the second growth, the more aggressive species of the red oak group occupying almost exclusively its place. Owing to the difficulty and scarcity of its natural regeneration, together with the fact that forest land suitable for its growth is occupied by the farmer, Prof. Mohr considers that so far as economic interests are concerned, the final extinction of the white oak will take place at no distant date. Even the immense forests of Kentucky and Tennessee are becoming exhausted. Future supplies of white oak must come from the forests south of the confluence of the Ohio and Mississippi rivers, and the sawmills are being moved southwards. Nashville, until a few years ago, was the most important market. At present Memphis, Mobile, and New Orleans are becoming the main centres, where white oak is sawn and marketed. (A. H.)

Ridgway gives many details of the size of white oak in the bottoms of southern Indiana and Illinois, the largest measured by Dr. J. Schneck in Wabash Co. being 150 ft. by 6 ft. in diameter with a clean bole 60 ft. long. The average of ten trees here was about 125 ft. in height by 4 ft. in diameter, whilst on the uplands in the same district the average height was only 100 ft. by 2·40 ft. in diameter.

In an article[1] on this tree by Sargent, good illustrations are given of the white oak in summer and winter from a tree growing in the grounds of Mr. Fearing, near Jobstown, New Jersey, which shows the form the tree assumes when grown in the open, like the park oaks of Great Britain; but though he says that the white oak in girth of stem and stoutness of branches is not second to its Old-World relative, the dimensions given by various writers do not show that any trees now exist which can rival our big English oaks. The tree in question is of no great height, and has a very short bole, 18 ft. in girth at 3 ft. from the ground. It is remarkable for its very wide-spreading and well-shaped crown, which covers a space 120 ft. in diameter.

Sargent also gives[2] a picture of a very beautiful and well-shaped tree at Shandy Hall, Maryland, which is 36 ft. in girth at the ground and 22 ft. just below the first limb at about 10 ft. The spread of the branches covers a circle 122½ ft. in diameter. In size, shape, and appearance, this tree is very similar to the Bourton Oak (Vol. II. Plate 93). In *Gard. Chron.* xxxiv. 51, figs. 19 and 20 (1903), some very large and old white oaks growing in the State reservation at Waverley, near Belmont, Massachusetts, are described and figured. The largest is about 80 ft. by 25 ft. in girth at 5 ft., and its age is estimated at 800 years, though there is no

[1] *Garden and Forest*, iv. 1, figs. 1, 2 (1891).

[2] *Ibid.* v. 254, fig. 50 (1892).

evidence that this species attains so great an age. It is said that during 100 years no seedling white oaks have come up in the reservation.

Prof. Sargent took me to see a fine white oak at Ponkapoug pond, near Boston, which was also very like an English park oak in habit, and measured about 60 ft. by 15 ft., with a spread of 40 paces. What was to my mind even more striking was the inhabited house of a settler dating from 1704, the white oak timbers and part of the weather-boarding of which was still quite sound, though unpainted for 200 years.

This oak has been repeatedly tried[1] in this country since its introduction in 1724, but has never thriven in our climate, the only specimens, except nursery plants at Kew, which we have seen[2] being a stunted tree at Tortworth, scarcely 20 ft. high, which was planted many years ago; and some plants at Aldenham, with sickly yellow foliage, planted eight years ago and reputed to be twenty years old from seed.

It seems to do rather better in France, where there are three trees at Les Barres in the old nursery, and some smaller ones which are not thriving. The best of them measure from 40 to 45 ft. high, and some produce acorns. At Verrières le Buisson, near Paris, in M. Philippe de Vilmorin's garden, there is a fairly healthy and well-grown tree, which, when I saw it last in 1905, measured 58 ft. by 4 ft. 2 in.

(H. J. E.)

## QUERCUS LYRATA, Overcup Oak

*Quercus lyrata*, Walter, *Fl. Car.* 235 (1788); Loudon, *Arb. et Frut. Brit.* iii. 1871 (1838); Sargent, *Silva N. Amer.* viii. 47, t. 374 (1895), and *Trees N. Amer.* 268 (1905).

A tree, attaining in America 100 ft. in height and 9 ft. in girth, but usually smaller. Bark broken into scaly plates. Young branchlets glabrous. Leaves (Plate 336, Fig. 31) deciduous and turning scarlet in autumn, 6 to 8 in. long, 2 to 3 in. wide, obovate, cuneate at the base, obtuse or acute at the apex, with five to nine lobes, the upper two lateral lobes broad, emarginate, and much larger than the middle and basal triangular lobes; upper surface dull green, with quickly deciduous minute scattered pubescence; lower surface pale, covered throughout with a minute pubescence; petiole ¼ to ¾ in. long, glabrous or with a few hairs.

Fruit ripening in the first year, sessile or on slender pubescent stalks; acorn pubescent in its upper half, almost or entirely enclosed in a nearly spherical thin cupule, pubescent within and covered with ovate tomentose scales, thick and twisted in the basal ranks, thinner and forming a ragged edge at the margin of the cupule.

This species is a native of river swamps and wet alluvial land, from Maryland south to Florida, and westward through the Gulf States to Trinity river, Texas, ascending the Mississippi basin to southern Indiana and Illinois, most common and attaining its largest size in Louisiana.

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[1] Loudon, in *Gard. Mag.* xix. 124 (1843), states that hundreds, even thousands of pounds, had been spent fruitlessly in the importation of acorns from America. In 1843, 30,000 plants which had been sent from New York, packed with moss in barrels, were said to have been thriving in a favourable soil in Surrey, but doubtless these soon perished.

[2] Loudon's account in *Arb. et Frut. Brit.* iii. 1868 (1838), of white oaks of large size in England is erroneous. In *Gard. Mag.* xviii. 656 (1842), he admits that there was only one tree known to him in England, growing in Loddiges' nursery. This was probably a young specimen. A supposed *Q. alba* at Muswell Hill was cut down in 1839, and a tree bearing that name at York House, Twickenham, was ascertained to be *Q. Prinus* by Loudon. Henry visited York House in 1904, and found no trace of this American oak.

The overcup oak was introduced[1] by Fraser in 1786, but Loudon only mentions in 1838 a small plant in Loddiges' nursery. Probably neglected by nurserymen, and unsuited for our climate, it is now nearly unknown in cultivation, the only specimens which we have seen being two trees in Kew Gardens, about 10 ft. high, which were obtained from the Arnold Arboretum in 1897. (A. H.)

## QUERCUS MACROCARPA, Burr Oak

*Quercus macrocarpa*, Michaux, *Hist. Chênes Am.* No. 2, tt. 2, 3 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1869 (1838); Sargent, *Silva N. Amer.* viii. 43, tt. 371, 372, 373 (1895), and *Trees N. Amer.* 267 (1905).

*Quercus olivæformis*,[2] Michaux f., *Hist. Arb. Am.* ii. 32, t. 2 (1812); Loudon, *Arb. et Frut. Brit.* iii. 1869 (1838).

A tree occasionally attaining in America 170 ft. in height and 20 ft. in girth. Bark, 1 to 2 in. thick, deeply furrowed, and broken on the surface into irregular flattened scales. Young branchlets stout, with a minute pubescence, gradually disappearing in summer. Buds ovoid, ⅛ to ¼ in. long, greyish tomentose; the terminal bud surrounded by persistent stipules. Leaves (Plate 336, Fig. 29) deciduous in autumn, turning dull brown before they fall, 6 to 12 in. long, 3 to 6 in. wide, obovate, rounded or acute at the apex; variable in outline, usually with five to seven lobes, the terminal lobe large, ovate, and crenately toothed, the lower lobes smaller, oblong, and separated by deep sinuses; occasionally, more regularly divided into more numerous shallower lobes; upper surface yellowish green, with quickly deciduous scattered hairs; lower surface pale, covered with a minute appressed pubescence, disappearing in greater part before the end of summer; petiole stout, pubescent, ½ to 1 in. long.

Fruit ripening in the first year, solitary or in pairs, sessile or long-stalked, variable in size and shape; acorn usually broad, ovoid, rounded or depressed at the apex, from ½ in. long in the north to 2 in. long in the south; cupule usually hemispheric, thick, pubescent within, covered externally with grey tomentose scales, tuberculate below, prolonged into awn-like tips above, forming a fringed border to the cupule.

*Q. macrocarpa* is remarkable for the corky wings[3] on the branchlets, sometimes an inch or more in width, when these are three or four years old.

A supposed hybrid[4] between this species and *Q. alba* was first discovered by M. S. Bebb at Fountaindale, Illinois, and has since been found in other localities.

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[1] Aiton, *Hort. Kew.* v. 295 (1813).

[2] This name was applied by Michaux to trees with deeply lobed leaves and small fruit; but the foliage is so variable on this species, even on the same individual, that it is doubtful if it can be maintained even as a varietal name.

[3] Cf. Miss Gregory, in *Bot. Gaz.* xiii. 254, pl. xxii. (1888).

[4] *Quercus Bebbiana*, Schneider, *Laubholzkunde*, i. 201 (1904).

A tree[1] of this kind is growing in the Arnold Arboretum, from the acorns of which Elwes has raised seedlings, which are not, however, growing vigorously at Colesborne, where the summers are too short and cold for it. (A. H.)

This is one of the most widely distributed oaks in North America, and extends farther to the northward and westward than any other of the eastern species. Its natural range is from Manitoba, the eastern foothills of the Rockies in Montana, the Dakotas, Nebraska, central Kansas, Indian Territory, and eastern Texas, eastward to the Atlantic coast. In the north-western states and about the Great Lakes, it sometimes grows in pure stands, forming the characteristic "oak openings," which are an intermediate region between the prairie and the forest. It resisted well the fires which constantly swept over this country before it was settled. An excellent picture of the type of tree found here is given in *Garden and Forest*, iii. 407 (1890), representing an oak near Whitewater, Wisconsin. In Manitoba, according to Macoun,[2] it forms thickets and open forests in many parts, sometimes becoming a fine tree, but dies out west of the Assiniboine. In Nova Scotia, New Brunswick, and westward through the valley of the St. Lawrence to Ontario, it is not so common and does not attain as large a size as *Q. alba*. It is most abundant and most important in the low ground of the Mississippi basin, where it is associated with white oak, lime, white ash, poplar, black walnut, and hickories. The largest dimensions given by Ridgway are of trees in Wabash county, Illinois, measured by Dr. J. Schneck—165 ft. by 22 ft., with a trunk 72 ft. long; and 162 ft. by 20 ft. East of the Alleghanies it is rare and local; and in the northern and north-western limits of its distribution, where the climate is cold and very dry, it dwindles to a mere shrub.

This species was introduced into England in 1811, but was rare in Loudon's time. Like most of the white oaks from eastern North America, it cannot be said to thrive in this country. From acorns which I gathered from a tree of no great size near Ottawa, I raised seedlings which, at first, were more vigorous than any of the American oaks that I raised at the same time, except the hybrid between this species and *Q. alba*, but are now, like the latter, apparently suffering from the soil and climate.

The best specimen we have seen is a tree at Eastnor Castle, which was 40 ft. high by 3 ft. in girth in 1905. Smaller trees are growing at Hildenley, Yorkshire, in Kew Gardens, at Tortworth, Orton, Fota, and Castlewellan. It does not appear to ripen fruit in this country, but I collected specimens with ripe acorns in September 1907 from a tree in M. Allard's arboretum at Angers, France. At Les Barres it seems to endure calcareous soil better than other American oaks, and has attained 13 metres in height; but Pardé does not think it likely to have any value as a forest tree in France.

According to Pinchot,[3] the burr oak is one of the most valuable hardwood trees in North America. The wood is heavy, hard, very strong, and durable; and in the market is not distinguished from white oak, and is used for the same purposes.

(H. J. E.)

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[1] This tree is one of several raised in the Arnold Arboretum from acorns taken from a hybrid oak growing near Charleville, Vermont. They reproduce the foliage of the parent, and grow more rapidly than trees of *Q. alba* and *Q. macrocarpa* in the same plantation. Cf. Sargent, *Silva N. Amer.* viii. 18, note 3, t. 350 (1895).

[2] In *Proc. Roy. Soc. Canada*, xii. pt. 4, p. 12.

[3] *U.S. Forest Service Circular* No. 56 (1907).

## QUERCUS LOBATA, CALIFORNIAN VALLEY OAK

*Quercus lobata*, Née, *Ann. Cienc. Nat.* iii. 277 (1801); Sargent, *Silva N. Amer.* viii. 23, t. 362 (1895), and *Trees N. Amer.* 261 (1905).
*Quercus Hindsii*, Bentham, *Bot. Voy. Sulphur*, 55 (1844).
*Quercus longiglanda*, Frémont, *Geograph. Mem. Upper California*, 15, 17 (1848).

A tree, attaining in California 100 to 130 ft. in height, with a trunk often 12 ft. and occasionally 20 to 30 ft. in girth. Bark about an inch thick, with small loosely appressed scales. Young branchlets slender, minutely pubescent. Buds ovoid, acute, ⅛ in. long, pubescent. Leaves (Plate 336, Fig. 30) deciduous in autumn, 2 to 3 in. long, 1 to 1½ in. broad, obovate or oblong, cuneate or rounded at the base, obtuse at the apex, with seven to eleven lobes, separated by sinuses of varying depth, the lateral lobes truncate or bidentate at their broad apex or triangular-ovate; upper surface dark green, with scattered minute stellate pubescence; lower surface paler, with denser similar pubescence; margin ciliate; petiole ⅛ to ½ in. long, pubescent.

Fruit ripening in the first year, sub-sessile, solitary or in pairs; acorns conical, elongated, 1 to 2 in. in length; cupule hemispheric, tomentose, the scales towards the base thickened and tuberculate, the others with long acute ciliate tips, the uppermost forming a fringe-like margin to the cupule.

This splendid tree is found in the valleys of western California, between the Sierra Nevada and the ocean, from the upper Sacramento to Tejon Pass. Alone or mixed with *Q. Wislizeni* and *Q. Douglasii*, it forms large open park-like groves. The Ukiah valley a few years ago was a vast forest of oaks, many of which still survive and are of a large size, Carl Purdy[1] having measured here in 1897 one tree 132 ft. high and 23 ft. 9 in. in girth, and another 120 ft. by 19½ ft. A heavy rainfall, rich soil, and sheltered situation have produced these surprising dimensions, unequalled by any other oaks on the Pacific Slope. Mr. Shinn[2] describes and figures a grove near Visalia, about 150 acres in extent, with trees 55 to 94 ft. in height and 11 to 15 ft. in girth. These grow on a heavy alluvial soil, rich in alkaline salts. Hilyard[3] also notices the growth of this tree on slightly alkaline soil, as in the delta lands of the Kaweah valley, where it forms a dense forest.

Mr. F. R. S. Balfour tells us that these oaks are the most conspicuous landmarks in the great central valleys of Sacramento and San Joaquin. They now stand solitary and stately in the vast expanse of wheat and barley in the grain tracts of Fresno, Merced, and other counties, which are now under cultivation. These trees were left to give shade in former times, when these districts were devoted to cattle-raising. The wood is remarkably brittle, and can only be used for firewood.

The date of introduction into Europe is uncertain; but Koch[4] had seen specimens in 1873 from Simon-Louis's nursery at Metz. It is rare in cultivation,[1] the only specimens which we have seen being a tree at Tortworth, about 20 ft. high, and another at Kew, about 30 ft. The latter is a narrow pyramidal fast-growing tree, the date of planting of which is unknown. (A. H.)

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[1] In *Garden and Forest*, x. 52, fig. 8 (1897).

[2] *Ibid.* x. 202, figs. 25, 26 (1897).

[3] *Soils*, 480 (1906).

[4] *Dendrologie*, ii. 2, p. 54 (1873).

## QUERCUS BICOLOR, Swamp White Oak

*Quercus bicolor*, Willdenow, in *Neue Schrift. Gesell. Natfr. Berlin*, iii. 396 (1801); Sargent, in *Bot. Gaz.* xliv. 226 (1907).

*Quercus platanoides*, Sudworth, *Rep. Agric. U.S.*, 1892, p. 327 (1893); Sargent, *Silva N. Amer.* viii. 63, tt. 380, 381 (1895), and *Trees N. Amer.* 269 (1905).

*Quercus Prinus*, β *platanoides*, Lamarck, *Dict.* i. 720 (1783).

*Quercus alba palustris*, Marshall, *Arbust. Am.* 120 (1785).

*Quercus Prinus*, β *tomentosa*, Michaux, *Hist. Chênes Am.* t. 9 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1876 (1838).

*Quercus Prinus discolor*, Michaux f., *Hist. Arb. Am.* ii. 46, t. 6 (1812).

*Quercus Prinus*, β *bicolor*, Spach, *Hist. Vég.* xi. 158 (1842).

A tree, attaining in America occasionally 100 ft. in height and 25 ft. in girth, usually much smaller. Bark of young trees separating into large membranous persistent scales, curling back and exposing the inner bark; on old trunks fissured into broad flat scaly ridges. Young branchlets glabrous. Buds ovoid, obtuse, pubescent, ⅛ in. long. Leaves (Plate 336, Fig. 37) deciduous in autumn, 5 to 6 in. long, 2 to 4 in. broad, obovate, rounded or acute at the narrowed apex, cuneate at the base, with six to eight pairs of rounded or acute small lobes; nerves more numerous than the lobes; upper surface shining green, with quickly deciduous scattered hairs; lower surface pale, often silvery white, covered with a dense tomentum, velvety to the touch; petiole about ½ in. long, slightly pubescent.

Fruit ripening in the first year, usually in pairs, on pubescent stalks; acorn edible, ovoid, about an inch long, pubescent at the apex, enclosed for one-third its length in a thick hemispherical cupule, covered with tomentose scales, those near the base thickened with twisted tips, those near the margin thinner and often forming a fringe-like rim.

A hybrid[2] between this species and *Q. alba* was discovered in 1894 by J. G. Jack at Chateaugay in Canada.

*Q. bicolor* is a native of Canada and of the northern and central parts of the United States, extending from the southern peninsula of Michigan, Ontario, south-western Quebec and southern Maine, southwards to the District of Columbia and northern Kentucky; extending along the Alleghany mountains to northern Georgia; and westwards to Iowa, Missouri, and Arkansas. It usually grows in small groves on the borders of streams and swamps, in moist fertile soil, but is nowhere abundant, and attains its largest size in western New York and northern Ohio. (A. H.)

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[1] Sargent, in *Silva N. Amer.* viii. 25, states that *Q. lobata*, like the other Californian oaks, does not succeed beyond the borders of its native state, and that attempts to establish it in eastern America and in Europe have not been successful.

[2] *Q. Jackiana*, Schneider, *Laubholzkunde*, i. 202 (1904).

An excellent account of this oak in *Garden and Forest*, iv. 241 (1891) says that in its young state, and until it has reached 20 to 30 ft. high, this species develops short stout branches which are very persistent and generally pendulous, as shown in the plate which accompanies the article. The bark separates into long thin papery scales, which remain long on the young trees, and give them a ragged appearance. I have noticed these peculiarities, in a minor degree, on some English-grown trees. The foliage of this oak when newly unfolded in spring is extremely beautiful, the upper surface being bronzed or green, and the lower side covered with white down. In autumn, however, they have no red or orange tints. Sargent says that the largest tree of this kind on record formerly grew at Wadsworth, on the Genesee river, New York, and measured 24 ft. in girth at the narrowest part of its trunk. As the timber is even more valuable than that of the white oak, and the trees bear transplanting better than that species, Sargent recommends planting it in deep moist soils.

In England, however, though introduced probably about 1800, the tree is very rare, and none of the specimens which we have seen look very thriving. Perhaps if it were planted on deeper and moister soils, free from lime, in the south of England, it might do better, but the seedlings raised from acorns collected in 1904 at Boston soon died at Colesborne. Loudon mentions no trees except small ones in the gardens of the Horticultural Society and of Loddiges.

The largest we know of is a tree at Syon, 59 ft. by 5½ ft., which seems healthy. Another at Arley Castle, planted about 1820, No. 36 of *Hortus Arleyensis*, was 50 ft. by 3 ft. 3 in. in 1904. A third at Corsham Court, growing in damp soil, measured 47 ft. by 3 ft. in 1905, and looked fairly healthy, though the twigs seemed to have been repeatedly cut back by frost. A small tree at Kew, with the bark scaling like that of a hickory, is healthy, but grows slowly. There is a well-grown tree in a rather cold and exposed situation at Lyndon Hall (Plate 329), 52 ft. by 4 ft. 3 in. This, when I saw it in 1909, had a large wound at 7 ft., nearly covered over by new wood, and though many young twigs were dead, there was still plenty of healthy foliage on 12th October.

In France the finest tree that I have seen is one at Verrières, 65 ft. by 6 ft. 1 in. in 1909. There is a tree about 35 ft. high in the collection at Les Barres, catalogued by Pardé as *Q. bicolor*, which was formerly named *Q. alba*. Prof. Sargent and Mr. Proctor, who saw it, considered it to be *Q. bicolor*, but Mr. Rehder, who saw it still later, thought that it was a hybrid between *alba* and *bicolor*.[1]

(H. J. E.)

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[1] Pardé, *Arb. Nat. des Barres*, 289, note 1 (1906).

## QUERCUS PRINUS, Chestnut Oak

*Quercus Prinus*, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1872 (1838); Sargent, *Silva N. America*, viii. 51, tt. 375, 376 (1895), and *Trees N. America*, 272 (1905).
*Quercus montana*, Willdenow, *Sp. Pl.* iv. 440 (1805).
*Quercus Castanea*, Emerson, *Trees Mass.* 137, t. 5 (1846).

A tree, occasionally attaining in America 100 ft. in height and 20 ft. in girth, but usually much smaller. Bark on young trees smooth, thin, shining, purplish brown; on old trunks about an inch thick, dark in colour, and divided into broad rounded scaly ridges. Young branchlets stout, glabrous. Buds ovoid, pointed, about ¼ in. long, pubescent at the tip, with reddish brown glabrous ciliate scales. Leaves (Plate 336, Fig. 36) deciduous in autumn, turning a dull orange or rusty brown before they fall, averaging about 6 in. long and 3 in. broad, obovate or elliptical; usually unequal and cuneate, rarely rounded at the base; apex acute or shortly acuminate; lateral nerves 10 to 13, each ending in a rounded or acute oblique crenate tooth; upper surface dark green, shining, glabrous; lower surface pale, covered with a fine pubescence, disappearing in summer; petiole glabrous, ½ to 1 in. long.

Fruit ripening in the first year, on stout stalks about ⅜ in. long, single or in pairs; acorn ovoid-oblong, about an inch long, shining, glabrous, enclosed nearly half its length in a thin hemispherical cup, pubescent within, and roughened or tuberculated externally, especially near the base, by the small appressed greyish pubescent scales, which are thickened in the centre and free at their tips.

This species closely resembles in foliage *Q. Mirbeckii*; but the leaves of the latter species are readily distinguished by the brown fluffy pubescence along the midrib on the lower surface.

The allied species, *Q. Michauxii*, Nuttall, formerly considered to be a variety of *Q. Prinus*, is not in cultivation, but is distinguished in the key, and figured on Plate 336, Fig. 34.

The chestnut oak ranges from southern Maine, the valley of the Genesee in New York, and the Bay of Quinte in Ontario, southwards to north-eastern Maryland, and along the Alleghany Mountains through the western portions of the Carolinas to northern Georgia and Alabama, becoming, however, in these two states small in size and confined to high altitudes, 2000 to 4500 ft. In the north, in Ontario and New England, it is rare and local and of no commercial importance. It is most abundant in the Alleghany Mountains from southern Pennsylvania, through Virginia, West Virginia, and Kentucky to central and eastern Tennessee. The tree is now found mostly on poor land, or on exposed hill-sides and high rocky ridges, where it often forms a quarter or a third of the hardwood forest in such situations, while on lower slopes and on alluvial land it seldom forms more than 5 per cent. It is mainly associated with *Q. velutina*, *Q. alba*, and hickories, and is slow in growth and intolerant of shade; and on this account tends to be excluded from the better soils and low altitudes, where hemlock, maple, and beech predominate.

A good illustration of the trunk and peculiar bark of this tree, taken from the Washington oak at Fishkill on the Hudson river, is given by Sargent,[1] who says that it may be eight or ten centuries old, and was 7 ft. in diameter in 1888.

This was one of the first American oaks introduced. Mentioned by Ray[2] in 1688, it was first figured and described by Plukenet[3] three years later, and is included[4] amongst the trees for sale in the Catalogue of the Society of Gardeners, published in 1730.

In Loudon's time it was a rare tree, as he only notices plants in Loddiges' nursery and in the Chiswick Garden. It apparently has not been successful in our climate, as the only specimens[5] which we have seen are small trees at Kew and at Westonbirt.

According to Foster and Ashe,[6] this species is becoming more valuable as a timber tree than formerly, as the wood is now used as a substitute for white oak. The best qualities are mixed with white oak and sold under that name. The wood is heavy, strong, tough, close-grained, and durable in contact with the soil, but is inclined to check in drying. It is dark brown in colour, with paler sapwood. Slightly softer than white oak, it does not take so high a polish. The medullary rays are not so broad as in the white oak, and when quarter-sawn the silver grain is not so pleasing. In western Virginia half the railway sleepers are now made of chestnut oak, where white oak was once the only wood accepted. In the northern factories it is now being put to uses for which only a few years ago white oak was considered essential, as for furniture, farm implements, tool handles, oil barrels, interior finish, and wagons. The inferior kinds are often marked with black specks, due to the burrowing of a minute larva.

Until about 1900 the great bulk of the chestnut oak was cut for the bark alone, the timber being abandoned in the forest. The bark is richer in tannin than any other of the eastern American oaks, and is still much used in local tanneries, and is also made into tannic acid for export. (A. H.)

## QUERCUS MUEHLENBERGII, Yellow Oak

*Quercus Muehlenbergii*, Engelmann, in *Trans. St. Louis Acad.* iii. 391 (1878); Sargent, in *Bot. Gaz.* xliv. 226 (1907).

*Quercus Prinus acuminata*, Michaux, *Hist. Chênes Am.* No. 5, t. 8 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1875 (1838).

*Quercus acuminata*, Sargent, in *Garden and Forest*, viii. 93 (1895), *Silva N. Amer.* viii. 55, t. 377, (1895), and *Trees N. Amer.* 273 (1905).

*Quercus Castanea*, Willdenow, *Neue Schrift. Gesell. Natfr. Berlin*, iii. 396 (1801) (not Née).

A tree, occasionally attaining in America 160 ft. in height and 12 ft. in girth above the broad and often buttressed base. It is mainly distinguished from

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[1] In *Garden and Forest*, i. 511, fig. 81 (1888).

[2] *Historia Plantarum*, ii. 1801 (1688).

[3] *Phytographia*, t. 54, f. 3 (1691).

[4] Cf. Loudon, *Arb. et Frut. Brit.* i. 68 (1838).

[5] The tree figured under this name in *Gard. Chron.* xiv. 617, fig. 101 (1893), is *Q. Mirbeckii.*

[6] *U.S. Forest Service Circular* No. 135 (1908).

*Q. Prinus* by the narrower leaves (Plate 336, Fig. 35), 4 to 7 in. long and 2 to 3 in. wide, with long narrow or short broad apices; with eight to ten pairs of inflexed teeth, glandular at their tips; upper surface yellowish green, glabrescent; lower surface pale with scattered minute pubescence; petiole ½ to 1 in. long, glabrescent.

Fruit smaller than in *Q. Prinus*; acorn broadly ovoid, ½ to ¾ in. long; cupule hemispherical, pubescent within, covered with appressed ovate tomentose scales, the lower ranks thickened, those above with free tips forming a fringe-like margin to the cupule.

This is the most important of the chestnut oaks, being more widely distributed than *Q. Prinus*, extending farther westward to Nebraska, Kansas, Indian Territory, and the Guadalupe mountains, Texas. It is rare and local in the Atlantic States, where it is usually found growing on limestone soils, from the district of Columbia and the valley of the Potomac northwards to Lake Champlain and southern Ontario. It is very abundant west of the Alleghany mountains, attaining an enormous size in the luxuriant forest of the Wabash valley in Indiana and Illinois.

Ridgway says of this tree[1] that it may be recognised at a distance by its thin-scaled very light-coloured bark and tall slender growth, being probably the tallest in proportion to its diameter of any of the white barked species. The tallest, however, that he measured was 130 ft. high by 13 ft. in girth; another 122 ft. high and 84 ft. to the first fork, was only 3½ ft. diameter on the top of the stump. He describes the acorns as very small and sweet, much resembling the nuts of *Castanea pumila* in appearance and taste. The wood is said to be tougher than that of *Q. alba*, and much used by wagon-builders.

This species, though said by Loudon to have been introduced in 1822, is one of the rarest oaks in cultivation in Europe. The only specimens which we know of are two trees, about 8 ft. high, at Aldenham, which were procured, under the name *Q. Esculus*, about eight years ago from a German nursery. The yellow-green leaves, turning scarlet or orange in autumn, are handsome and peculiar, owing to their wrinkled uneven margin, caused by the teeth being turned inwards and upwards. (A. H.)

## QUERCUS PRINOIDES

*Quercus prinoides*, Willdenow, in *Neue Schrift. Gesell. Natfr. Berlin*, iii. 397 (1801); Sargent, *Silva N. Amer.* viii. 59, t. 378 (1895).
*Quercus Prinus humilis*, Marshall, *Arbust. Am.* 125 (1785).
*Quercus Prinus pumila*, Michaux, *Hist. Chênes Am.* No. 5, t. 9, f. 1 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1875 (1838).
*Quercus Prinus Chincapin*, Michaux f., *Hist. Arb. Am.* ii. 64, t. 10 (1812).
*Quercus Chinquapin*, Pursh, *Fl. Am. Sept.* ii. 634 (1814).
*Quercus Muehlenbergii*, var. *humilis*, Britton, in *Bull. Torrey Bot. Club*, xiii. 41 (1886).

A shrub, 12 to 15 ft. high. Young branchlets glabrous. Buds ovoid, obtuse, glabrous, ⅛ in. long. Leaves (Plate 336, Fig. 38) deciduous in autumn, turning orange and scarlet before falling, about 4 in. long and 2 in. broad, obovate or ovate, acute at the apex, cuneate at the base; with four to seven pairs of acute or rounded teeth; lateral nerves five to eight pairs; upper surface dark green, with scattered glandular hairs; lower surface pale, with scattered minute pubescence; petiole glabrous, ¼ to ½ in. long.

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[1] *Proc. U.S. Nat. Mus.*, 1882, p. 82 (*in separata*).

Fruit ripening in the first year, clustered, sessile; acorn edible, ovoid, ½ to ¾ in. long, white pubescent and rounded at the apex, enclosed for half its length in a hemispherical cupule, pubescent within, and covered with grey tomentose scales, large and thickened in the lower ranks, thin and forming a fringe-like rim at the upper margin of the cupule.

This is usually a low shrub, spreading by root suckers, and growing on rocky slopes and hill-sides. It is distributed from Massachusetts to North Carolina, extending westward to Nebraska, Kansas, Indian Territory, and eastern Texas, where it is often seen on the low undulating prairies.

It was introduced in 1823, but is very rare in cultivation, the only specimens which we have seen being at Kew and Tortworth, where it does not appear to bear fruit. (A. H.)

## QUERCUS OBTUSATA

*Quercus obtusata*, Humboldt and Bonpland, *Pl. Æquin.* ii. 26, t. 76 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1942 (1838); De Candolle, *Prod.* xvi. 2, p. 27 (1864); Hemsley, *Biol. Centrali-Amer. Bot.* iii. 175 (1882).

*Quercus pandurata*, Humboldt and Bonpland, *Pl. Æquin.* ii. 28, t. 77 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1942 (1838).

*Quercus ambigua*, Humboldt and Bonpland, *Pl. Æquin.* ii. 51, t. 93 (1813) (not Michaux).

*Quercus Hartwegi*, Bentham, *Pl. Hartweg*, 56 (1839).

*Quercus affinis*, Martens et Galeotti, in *Bull. Acad. Brux.* x. 222 (1843).

*Quercus nudinervis*, Liebmann, in Seemann, *Bot. Herald*, 334 (1852-57), and in *Overs. K. Dansk. Vidensk. Selsb. Forhand.*, 1854, p. 182.

A large tree in Mexico. Young branchlets with quickly deciduous scattered minute hairs. Buds ovoid, ⅛ in. long, obtuse, with reddish brown glabrous ciliate scales. Leaves (Plate 333, Fig. 4), deciduous late in the season (January to March), coriaceous, averaging 4 in. long and 2 in. broad, obovate or obovate-oblong; narrowed and auricled at the base; usually rounded, rarely acute, at the apex; margin with irregular callous-tipped crenate inflexed teeth, variable in size and number, and often obsolete; lateral nerves, ten to twelve, mostly ending in the margin; upper surface dark green, glabrous; lower surface pale or greyish green, glabrous; petiole ¼ to ½ in., stout, glabrous.

Staminate catkins, slender, filiform, 1½ to 2 in. long, covered with white hairs; calyx pilose; anthers six, glabrous. Pistillate flowers two or three, on a slender densely pubescent stalk about ¾ in. long.

Fruit, ripening in the first year, solitary or two to three on a slender glabrescent stalk averaging 1½ in. in length; acorn ovoid, ¾ in. long, glabrescent, with a pubescent umbo, enclosed for one-third its length in a hemispherical cupule, ½ in. in diameter, tomentose within, and covered with closely appressed tomentose scales, reddish at their apices, those at the margin of the cupule minute, gradually increasing in size and thickened towards the base.

The above description is taken from specimens in cultivation, which show considerable variation in the shape of the leaves. Herbarium specimens from Mexico show greater variation, and have been grouped by De Candolle into three forms, the type and two varieties, *pandurata* and *Hartwegi*.

This species appears to be widely spread in the mountains of southern Mexico, where it was discovered by Humboldt near Ario, at an elevation of 6000 ft. He describes it as a lofty tree, 3 to 4 ft. in diameter, with very thick deeply cracked bark, and very compact strong wood, susceptible of taking a fine polish. Galeotti found this oak in the woods and savannas of Mirador and Zacuapan at 2500 to 3000 ft. altitude. It was collected by Hartweg at Tuxpan near Anganguio, by Bourgeau near Santa Fé, and by Berlandier between Tula and Tampico. Seemann found it also on the Cerro de Pinal in northern Mexico.

Specimens of this oak, described by Bentham as *Q. Hartwegi*, were sent by Hartweg to the Horticultural Society in 1839; and seedlings probably were raised in the Chiswick Garden, though there is no definite record of its cultivation.

(A. H.)

The finest specimen which we have seen is a tree in the Cambridge Botanic Garden, which is grafted on the common oak. It retains its leaves till March or April, and does not appear to suffer from severe winters. In 1908, a favourable season, it bore well-formed acorns; but in 1909 none of the fruit ripened.

A small tree, about 12 ft. high, at Kew, was obtained from Smith of Worcester in 1873. It has long borne the label *Q. genuensis*; but this appears to be an abbreviation of *Q. rugosa*[1] *genuensis*, the name applied to a tree at Glasnevin, about 16 ft. high, which was obtained from the same firm in 1885.

At Kilmacurragh, Co. Wicklow, there is a good specimen, reported by Capt. Acton to be 36 ft. high and 2 ft. 8 in. in girth. Its history is unknown.

This species is also in cultivation at Westonbirt; where a number of uncommon oaks were planted in Silkwood by the late Mr. Holford, on soil too dry and thin to enable them to develop themselves. (H. J. E.)

## QUERCUS TOZA, Pyrenean Oak

*Quercus Toza*, Bosc, in *Journ. Hist. Nat.* ii. 155 (1792); Mathieu, *Flore Forestière*, 359 (1897).
*Quercus pyrenaica*, Willdenow, *Sp. Pl.* iv. 451 (1805); Loudon, *Arb. et Frut. Brit.* iii. 1842 (1838).
*Quercus Tauzin*, Persoon, *Syn. Pl.* ii. 571 (1807).
*Quercus stolonifera*, Lapeyrouse, *Pl. Pyren.* 582 (1813).

A tree, attaining about 70 ft. in height and 10 ft. in girth, but usually smaller; producing root-suckers freely. Bark dark brown, fissured longitudinally. Young branchlets covered with a dense grey tomentum, persistent in part in the second and third year. Buds $\frac{1}{8}$ in. long, pale brown, ovoid, obtuse, pubescent. Leaves (Plate 335, Fig. 28) deciduous in autumn, 4 to 8 in. long, 3 to 4 in. wide, oval or obovate, variable in shape, acute or obtuse at the apex, cuneate or sub-cordate at the base; usually pinnatifid, with five or six pairs of deep, entire or sinuately-toothed lobes, either oblong, rounded at the apex, and with narrow sinuses, or triangular and acute with wide sinuses; upper surface dark green, stellate-pubescent; lower surface grey or whitish, covered with a dense soft tomentum; lateral nerves more numerous than the lobes; margin ciliate; petiole about $\frac{1}{2}$ in. long, tomentose.

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[1] *Q. rugosa*, Née, *Ann. Cienc. Nat.* iii. 275 (1801), is a different Mexican species, identified by De Candolle with *Q. crassifolia*, Humboldt and Bonpland.

Fruit ripening in the first year, two to four on a tomentose, usually erect, rarely pendulous stalk, $\frac{1}{2}$ to 2 in. long; acorn variable in size and shape, cylindrical, ovoid or globose, pubescent at the apex, elsewhere glabrous; cupule hemispheric, $\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter, with tomentose scales, closely appressed, except near the margin of the cup, where they are occasionally slightly spreading at their tips.

*Q. Toza* varies extremely in the size and shape of the foliage, and in Portugal hybridises occasionally both with *Q. lusitanica*[1] near Coimbra, and with *Q. pedunculata* near Castello Novo, where Padre Tavares showed Elwes trees which he considered to be intermediate between them.

At Angers, where *Q. Toza* is found growing in the hedges with both *Q. pedunculata* and *Q. sessiliflora*, it forms occasional hybrids with these species, which have been described by Abbé Hy.[2]

A small tree at Tortworth appears to be a hybrid between this species and *Q. pedunculata*. Its leaves are variable in size and shape, usually more deeply lobed than *Q. pedunculata*, of which it has the auricles at the base; less deeply lobed than *Q. Toza*, and greyish tomentose beneath, as in the latter species. It bears fruit freely, intermediate in character between the two species, from which seedlings have been reared at Colesborne, which resemble the parent tree in foliage.

## DISTRIBUTION

This oak is a native of south-western France, and of Spain and Portugal. In France it is more or less common in the departments of the Basses-Pyrénées, Gers, Landes, Lot-et-Garonne, Gironde, Dordogne, Charente, and Charente Inférieure; and scattered trees are met with as far north as Angers and Le Mans. Its distribution is thus confined to near the coast and to low altitudes; as it succumbs to the cold winters, which occasionally occur in the interior, a temperature of $-4°$ Fahr. being fatal to it. In the Landes,[3] a tenth of these oaks were killed in 1829-30, when the thermometer fell to 5° Fahr. A plantation[4] of this species at Les Barres, made in 1829-34, was almost entirely destroyed by the severe winter of 1871-72. In France, it is usually a low tree, with a short and crooked stem, doubtless due to the bad soil where it is mainly found, as in favourable situations moderately tall trees with straight stems are met with. It commonly grows unmixed with other trees on almost pure sand or on sandy clays; but is occasionally seen in mixture with *Q. pedunculata.* It is usually treated as coppice, as it regenerates freely from cut stools and from the roots; but is of little value except for its bark and for firewood. It produces fruit abundantly every year; and the woods in which this species occurs near Bayonne are celebrated for fattening pigs. (A. H.)

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[1] Coutinho, in *Bull. Soc. Brotero*, vi. 57 (1886).

[2] *Q. Trabuti* and *Q. Guerangeri*, Hy, in *Bull. Soc. Bot. France*, xvii. 556, 557 (1895), are names given to supposed crosses with *Q. sessiliflora*. *Q. Rechini*, and *Q. andegavensis*, Hy, *op. cit.* 557, 558, are names applied to the hybrids with *Q. pedunculata.*

[3] Dufour, quoted by Mathieu, *op. cit.* 360.

[4] Pardé, *Arb. Nat. des Barres*, 288 (1906).

This is one of the common trees of the north of Spain and Portugal, extending from the Pyrenees through the Cantabrian mountains to Portugal; and according to Laguna[1] is found more or less in every province of Spain, occurring in the Sierra de Gredos up to 5000 ft., and in the Sierra Nevada to 6000 ft. In Galicia, according to Gadow,[2] it is abundant from about 1000 to nearly 3000 ft. Barros Gomes[3] says that it is with the chestnut, the dominant tree in Beira Trasmontana, on the upper Lezera, the Côa, and the Serra de Montemuro, at an elevation of 200 to 1500 metres. I found it mixed with *Q. pedunculata* in the Serra do Gerez in north Portugal, at about 3000 ft., and abundantly near Castello Novo in Beira Baixa, where it varies very much in the shape and size of its foliage, and was in full leaf by the end of April.

It is known in Galicia as *cerquinho*, and in the Serra do Gerez as *carvalho cerquhino*, meaning little oak. In Portugal it is sometimes called *negral* or *carvalho negro*; near Santander, *roble negro* or *tocio*; and in the mountains of Cuenca, *melojo.* It is rarely allowed to become a large tree, the branches being lopped as fodder for goats and cattle, and it never seems to attain the size of the common and cork oaks, the largest that I saw or heard of, near Castello Novo, which, however, were not old trees, were about 70 ft. by 7½ ft.[4]

It usually bears numbers of large galls, produced by *Cynips Tozæ*, Bosc, which are also characteristic of *Q. lusitanica*, and are described and figured, with many other galls, in a valuable paper by Padre Joaquim da Silva Tavares.[5]

### CULTIVATION

This species is said by Loudon to have been introduced in 1822, but the tree at Clonmannon is probably older than this date. It never seems to have been popular with nurserymen, and possibly is short-lived.

In England, the best tree appears to be one at Strete Ralegh, which Miss F. Woolward reports to be about 40 ft. high, but with the branches much broken by wind. There is a good specimen at Tortworth, and others at Kew, Syon, Melbury, and Westonbirt.

At Smeaton Hepburn, East Lothian, Sir Archibald Buchan-Hepburn, Bart., reports a tree which, although it has lost 12 ft. of its leader, is 35 ft. high and 4½ ft. in girth. The branches are distinctly pendulous, but have been repeatedly broken by north-westerly gales.

The finest tree that we know of is at Clonmannon, Co. Wicklow, which, when seen by Henry in 1904, measured 66 ft. in height and 9 ft. in girth; but was beginning to be attacked by a fungus, a portion of the butt being unsound (Plate 330). There is no authentic information to be obtained concerning the date of planting of this remarkable tree. A tree, 40 ft. by 2½ ft., in the same year, is thriving at Kilmacurragh in the same county. (H. J. E.)

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[1] *Flora Forestal Española*, 232 (1883).

[2] *Northern Spain*, 389 (1897).

[3] *Journ. Sc., Acad. Sci., Lisbon*, v. 235 (1876).

[4] A large tree in the forest of Bussaco is figured in *Bull. Soc. Dend. France*, 1905, p. 5.

[5] *Broteriá*, vi. t. vi. fig. 6 (Lisbon, 1905).

## QUERCUS CONFERTA, HUNGARIAN OAK

*Quercus conferta*, Kitaibel, in Schultes, *Östr. Fl.* i. 619 (1814); Masters, in *Gard. Chron.* v. 85, fig. 18 (1876).

*Quercus farnetto*, Tenore, *Cat. Pl. Hort. Neap.* 65 (1819).

*Quercus apennina*, Loiseleur, in *Nouv. Duham.* vii. 177 (1819) (not Lamarck).

*Quercus hungarica*, Hubeny, in *Gemein. Blätt. Ofn. u. Pesth. Zeitschr.* xx. 2, p. 754 (1830); Willkomm, *Forstliche Flora*, 412 (1887); Hempel u. Wilhelm, *Bäume und Sträucher*, ii. 71, t. 24 (1889); Beck, *Vegetationsverhält. illyrisch. Länd.* 210 (1901).

*Quercus pannonica*, Booth, *ex* Gordon, in Loudon, *Gard. Mag.* xvi. 637 (1840).

A tree, attaining 100 ft. in height and 12 ft. in girth. Bark less deeply fissured than that of *Q. sessiliflora*, broken on the surface into small square scaly plates. Young branchlets with scattered hairs. Buds (Plate 78, Fig. 5) ovoid, obtuse, ⅛ in. long, with pubescent ciliate scales. Leaves (Plate 335, Fig. 26) deciduous[1] in autumn, about 6 in. long and 4 in. broad, obovate, rounded at the apex, usually subcordate at the base, with six to eight pairs of oblong, entire or sinuately-toothed lobes, with sinuses extending about half way to the midrib; margin ciliate; upper surface dull green, with a quickly deciduous scattered minute pubescence; lower surface greyish or pale green, covered with a thin stellate tomentum; petiole ¼ to ½ in. long, pubescent.

Fruit ripening in the first year, three or four clustered on a short stout pubescent peduncle; acorn ½ to ¾ in. long, rounded at the apex; cupule hemispherical, ½ to ¾ in. broad, with tomentose loosely appressed scales.

This species is closely allied to *Q. Toza*; but has thinner, not so densely tomentose leaves, and almost glabrous branchlets. It is reported[2] to hybridize with *Q. sessiliflora*, *Q. pedunculata*, and *Q. lanuginosa*.

### DISTRIBUTION

This oak is a native of south-eastern Europe, attaining its northern limit in the southern provinces of the Hungarian kingdom, where it is widely spread through Slavonia, Banat, and the adjoining districts to Transylvania. It extends southwards through the Balkan States, Bulgaria, and northern Greece; and is also found in southern Italy.

In Italy, according to Borzi,[3] *Q. conferta* is not found north of lat. 42°, but is common, either pure in small woods, or mixed with *Q. sessiliflora* and *Q. Cerris*, in the hills of southern Latium, in the Terra di Lavoro, and in the southern part of the Abruzzi as far as the slopes of Mt. Gargano. Farther south it gradually becomes rare and sporadic, and is not seen in the extreme south of Calabria. Its occurrence in Sicily is doubtful, as it has not been found recently by Lojacano in the locality near Taormina, where specimens were gathered by Di Leo and sent to Borzi in 1884.

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[1] M‘Nab exhibited a branch of a tree, growing at Edinburgh, which retained its leaves fresh and green in January. This was probably a young tree. Cf. *Gard. Chron.* v. 113 (1876).

[2] Schneider, *Laubholzkunde*, i. 194 (1904).

[3] *Fl. Forestal Ital.* 167 (1880), and in *Boll. R. Orto. Bot. Palermo*, iv. 48 (1905).

In southern Hungary and Servia, it is one of the constituents of the oak forests, found on the hilly land and the lower slopes of the mountains, its companions being *Q. sessiliflora* and *Q. Cerris*; and is not met with in the great oak forests of the alluvial plains, where *Q. pedunculata* is the sole species. It usually grows on dry slopes with a sunny aspect, for which it is well adapted by its pubescent leaves. These check evaporation of water; and on hot days in summer in the Drina valley, I observed the leaves on the upper part of the tree, exposed to the sun, turning their greyish under surfaces to the east in the morning and to the west in the afternoon. It occupies drier situations than *Q. sessiliflora*; but does not ascend on the hot exposed ridges, with shallower soil, to as great an altitude as *Q. Cerris*, which often forms pure forests at 3000 ft. elevation.

*Q. conferta* becomes less common west of the Drina valley, and is only met with in Bosnia in the mountains south of the Save, east of Brčka, and in the valleys of the Drina and Lim rivers.

In Herzegovina, *Q. conferta* occurs in a few localities in the Narenta valley, the most important being the large forest of Dobrava, south of Mostar and west of Stolac, which is composed of a mixture of this species with *Q. Cerris* and *Q. macedonica*. Similar woods are met with in Montenegro and in Albania.

In Roumania, according to Huffel,[1] it occasionally forms pure woods; but is more commonly mixed with *Q. Cerris*; and in rare cases grows on moist clay soil with *Q. pedunculata*.

The largest tree,[2] which I measured in an oak forest in the Drina valley at about 1000 ft. elevation, was 85 ft. high and 12 ft. in girth; and here it seemed to be outgrown by the Turkey oaks standing beside it, which attained about 100 ft. by 10 ft.; but I was informed that in many places it grew to a larger size, equalling *Q. sessiliflora* in height and girth.

*Q. sessiliflora* and *Q. conferta*, growing in the hills in Servia, produce timber which is practically indistinguishable and is exported under the same name. In Slavonia, this hill oak timber is sold, for similar sizes, at about two-thirds the price of the wood of *Q. pedunculata*. The latter, grown in the forests of the alluvial plain of the Save, in moist ground, exposed to floods, is claimed locally to be the best oak in the world; and sells in the forest, close to the railway, when of the best quality and over 3½ ft. in diameter, at about a shilling per cubic foot.

Huffel, speaking of the wood of *Q. conferta* in Roumania, says that it has the peculiar property of breaking transversely, when force is applied, as neatly as if cut with a saw; and that, on this account, it is unsuitable for building purposes; but he adds that it rends well, is beautifully figured, and not liable to crack or warp in drying. (A. H.)

## Cultivation

*Q. conferta* was introduced into England shortly before 1838, as Loudon[3] mentions, as a possible variety of *Q. Toza*, an oak, in the Horticultural Society's

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[1] *Les Forêts de la Roumanie*, 4 (1900).

[2] A tree cut down in this forest, ninety-five years old, showed on a radius of 14 in., 11 in. of heartwood with 85 annual rings, and 3 in. of sapwood with 10 rings.

[3] *Arb. et Frut. Brit.* iii. 1844 (1838).

Garden at Chiswick, which had been received from Pesth, under the name *Q. conferta*; and Gordon,[1] in a list of the plants cultivated at Chiswick in 1839, enumerates *Q. pannonica*, which had been obtained from Booth of Hamburg. Grafted plants[2] were sold soon afterwards in considerable quantity by Lawson of Edinburgh. The species is, however, quite rare in England, though it seems to grow well where it has been planted in the southern and midland counties.

The largest we know is at Orton Hall, which in 1905 measured 68 ft. by 8½ ft., and is apparently grafted on the common oak (Plate 331). At Beauport there is a fine tree 67 ft. by 7 ft. 3 in. in 1909. At Westonbirt a well-grown tree in the arboretum measured 53 ft. by 5 ft. in 1909. At Kew[3] a fine young tree is about 45 ft. by 6 ft. At Tortworth a well-shaped and thriving specimen was 41 ft. by 3 ft. in 1904. At Osterley Park, there are two healthy young trees about 35 ft. high. Smaller ones are growing at Bicton, Grayswood near Haslemere, Liphook, Sawbridgeworth, and Aldenham.

In the Edinburgh Botanic Garden, a tree,[4] planted in its present position by Sir W. Gibson Craig in 1866, measured in 1905, 39 ft. by 5 ft.; and another, planted by Dr. Masters in 1875, measured in 1905, 30 ft. by 3½ ft. (H. J. E.)

## QUERCUS MIRBECKII, ALGERIAN OAK

*Quercus Mirbeckii*, Durieu, in Duchartre, *Rev. Bot.* ii. 426 (1847); Mathieu, *Flore Forestière*, 362 (1897).
*Quercus lusitanica*, Webb, sub-species *bætica*, De Candolle, *Prod.* xvi. 2, p. 19 (1864).
*Quercus Prinus*, Masters, in *Gard. Chron.* xiv. 617, fig. 101 (1893) (not Linnæus).

A tree, attaining in Algeria 120 ft. in height and 20 ft. in girth. Bark thick, hard, dark coloured, and deeply fissured into narrow scaly plates. Young branchlets glabrous, or with a few scattered hairs. Buds (Plate 78, Fig. 6) ovoid, angled, pointed, about ¼ in. long; scales pubescent, ciliate. Leaves (Plate 337, Fig. 44) deciduous in January, February, and March, variable in size and shape, the wider obovate leaves averaging 4 in. long and 3 in. broad, the narrower oval leaves nearly as long, and about 2 in. wide; acute at the apex; truncate, rounded, or auricled at the base; with nine to fourteen pairs of lateral nerves, each, except the lowest one or two pairs, ending in a rounded or acute tooth or short lobe; upper surface dark green, glabrous, except for slight pubescence at the base of the midrib; lower surface paler or slightly glaucous, glabrous, except for a brown flocculent tomentum along the midrib, especially at its base; petiole, ½ to ¾ in. long, brown tomentose in part.

Fruit ripening in the first year, clustered, sessile; cupule nearly hemispheric, ¾ in. wide, with appressed tomentose scales, those at the base oval, thickened, and larger than the narrow triangular scales towards the thin margin; acorn ovoid, about an inch long, glabrous.

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[1] In Loudon, *Gard. Mag.* xvi. 637 (1840).

[2] Cf. Masters, in *Gard. Chron.* v. 85 (1876).

[3] This tree is mentioned under the name *Q. sessiliflora pannonica*, by Hemsley, in *Gard. Chron.* iv. 455 (1875).

[4] This tree was 20 ft. high in 1876, and was one of Lawson's original plants, which had been for some time in the garden in an unsuitable site. Cf. *Gard. Chron.* v. 86 (1876).

This species in Algeria varies[1] considerably in the size and shape of the leaves, the largest and most obovate forms occurring in the rainy districts near the coast; while small and narrow leaves are characteristic of the trees growing in the dry mountains of the interior, as in the cedar forest of Teniet-el-Hâad, where the specimens which I collected are scarcely half the size of those of the coast forest of Akfadou. In the driest regions of the western part of Algeria, where the soil is limestone, the leaves are not only small, but are covered beneath with a thin tomentum, constituting var. *tlemcensis*, Warion.[2]

*Q. Mirbeckii* also occasionally forms hybrids with *Q. Suber*, a tree of this kind with corky bark found in the forest of Tlemcen being *Q. Pseudosuber*, Desfontaines, *Fl. Atlant.* ii. 348 (1800) (not Santi). A similar tree has lately been found in the same forest by M. Trabut.

### Distribution

This species is a native of southern Portugal (where it seems to be rare,[3] and confined to the province of Algarve), Morocco, Algeria, and Tunis. Little is known of its distribution in Morocco, where it was collected in the mountains near Tangier by Ball in 1862; while in Tunis it appears to be limited to and not abundant in the Khroumir mountains. In western Algeria and throughout the Atlas range, owing probably to the insufficient rainfall, *Q. Mirbeckii* grows only in a few localities, on the northern slopes of the mountains, as in the forest of Hafir, near Tlemcen, at Nesmoth, around Ténès, at Teniet-el-Hâad, Matmata, and Blida. At Teniet-el-Hâad it grows in company with the cedar, from 4700 ft. to the summit at 5900 ft., and forms wide-spreading branching trees often 12 ft. in girth. This oak is much more abundant and of considerable commercial importance in the extensive broad-leaved forests, which are situated in the mountains near the coast, in eastern Kabylia and in the province of Constantine, where the rainfall is heavy. The forest of Akfadou, near Bongie, which I visited in January 1907, is mainly composed of oaks, with a slight admixture of maples, willows, cherry, and holly. In the lower zone, between 1500 and 3000 ft., *Q. Suber* predominates, with a few scattered small trees of *Q. Mirbeckii*; above 3000 ft. the latter becomes the main species, and increases in size, the cork oak ceasing at about 3700 ft., and being replaced by *Q. castaneæfolia*. Above this level to the summit, about 5000 ft., the forest is an equal mixture of the latter species and *Q. Mirbeckii* (Plate 323). In this forest the largest *Q. Mirbeckii* is reported to be 17 ft. in girth; but I saw none exceeding 13 ft., and the tallest tree which I measured was 90 ft. by 8 ft. 4 in. M. Trabut informed me that the finest forest of this species, nearly pure, is at Ain-ma-beurd, near Djidjelli, where the trees rival in height and in density upon the ground those of *Q. sessiliflora* in the famous forest[4] of Bercé, in France. The total annual yield of timber of *Q. Mirbeckii* in the forests of eastern Algeria is said to be about 3,500,000 cubic feet.

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[1] Cf. Trabut, in *Rev. Gén. de Bot.* iv. 1-6, figs. 1-3 (1892).

[2] *Ex* Battandier et Trabut, *Fl. Algér.* 821 (1890).

[3] The only specimen which I have seen from Portugal, is one collected by Welwitsch, on the Serra da Picota in Algarve. This specimen is in the Kew herbarium.

[4] Cf. vol. ii. p. 331.

The wood is very dense and heavy, sinking in water when green, and in the dry state having a specific gravity of 0·924. It is easy to rend, but is very liable to warp and split when drying. In structure it differs from the wood of the common oak in having smaller and fewer large pores in the zone formed in spring, these being represented by one, or at most two, rows, the greater part of the annual ring, that formed in autumn, being composed of fibrous tissue. The timber is valuable for building purposes, and for other uses similar to those of the common oak, but up to the present it has been mainly used in Algeria for railway sleepers.

(A. H.)

## CULTIVATION

This species was introduced[1] about 1844 or 1845, when King Louis Philippe sent acorns, which had been procured in Algeria, to Queen Victoria, who distributed them amongst the ladies of the court. *Q. Mirbeckii* has handsome foliage, which is subevergreen, and thrives well in the warmer parts of England; and, though we have found no trees in Wales, Scotland, or Ireland, no doubt it would succeed there in many localities.

The largest tree we know of is at Bicton, where in 1902 I measured one 75 ft. high and 12 ft. 9 in. in girth, with a spreading crown 30 paces in diameter. At Tregothnan Mr. A. B. Jackson measured a tree about 60 ft. high and 6½ ft. in girth in 1908.

At Ham Manor, near Worthing, there are two fine trees, the largest of which in 1907 was 70 ft. by 8 ft. 3 in.; the other, close to it, was about 60 ft. by 7 ft.

On a lawn at Hursley Park, Winchester, there is a well-shaped specimen which in 1906 measured 62 ft. by 7½ ft. (Plate 332). I am informed by Colonel Heathcote that it is known as "The Speaker's Oak," because the late Lord Eversley, who was Speaker of the House of Commons from 1837 to 1857, and an intimate friend of the late Sir William Heathcote, then of Hursley, jumped over the tree when it was planted.

At Syon there is a tree 53 ft. by 5 ft. 3 in. in 1904, when it ripened a large number of acorns. Some of these which were sown at Colesborne have grown well, and carry their leaves until spring. An older tree, purchased under the name of *Q. afghanistanica*, has proved quite hardy at the same place, though planted in a situation very subject to spring frost, on a cold clay soil.

At Albury there is a small tree 24 ft. high, forking near the ground into two stems, each 2½ ft. in girth, which was figured in the *Gardeners' Chronicle*, xiv. 617 (1893) as *Q. Prinus*. At Melbury there is a tree about 40 ft. by 4 ft. in 1909. In the Victoria Park, Bath, another is about 50 ft. At Blenheim, Westonbirt, Tortworth, Howick in Northumberland, and in the Cambridge Botanic Garden there are trees of smaller size.

At Tockington Manor, Gloucestershire, Capt. H. Pomeroy Salmon has two trees

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[1] See correspondence at Kew with Mr. J. W. Ford, of Enfield Old Park, Winchmore Hill, who gives an account of the origin of an old tree of this species which was cut down near Enfield in 1900.

24 ft. and 17 ft. high, which he raised from acorns collected in the Atlas mountains, where the Kabyles grind the acorns and mix the flour with barley meal to make cakes. He adds that the native name is *Abelude n'zān*, which has been corrupted by French authors into *zéen*. (H. J. E.)

## QUERCUS PONTICA

*Quercus pontica*, Koch, in *Linnæa*, xxii. 319 (1849); De Candolle, *Prod.* xvi. 2, p. 49 (1864); Dieck, in *Gartenflora*, xl. 509, fig. 95 (1891); Albow, *Prod. Fl. Colch.* 219 (1895); Schneider, *Laubholzkunde*, i. 192, fig. 102 (1904).

A shrub, attaining 10 to 13 ft. in height. Young branchlets stout, glabrous. Leaves (Plate 339, Fig. 70) deciduous, elliptic, about 6 in. long and 3 in. broad, often larger on young plants, coriaceous, cuspidate or shortly acuminate at the apex, rounded at the base; with 15 to 20 pairs of parallel lateral nerves, prominent beneath, each ending in a large triangular incurved cartilaginous-tipped serration; upper surface dark shining green, glabrous; lower surface glaucous, glabrous except for a few scattered long hairs on the midrib and lateral nerves; petiole stout, swollen at the base, ¼ to ½ in. long, glabrescent.

Fruit not seen. Its affinities are probably with *Q. Mirbeckii*

This species is readily distinguished by its remarkable buds, which are stout, ovoid, pointed, about ½ in. long; scales glabrous, green, with a brown ciliated margin.

This species was discovered by Koch in north-eastern Asia Minor, in the mountains of Lazistan, near the source of the river Asperos, where, in company with alder and beech, it forms a shrubby vegetation above the conifer region, from 5000 to 7000 ft. elevation.

It is also widely spread in the mountains of Caucasia, which border on the eastern shore of the Black Sea, where it has been found in numerous stations, in Abkhasia, Mingrelia, Imeritia, Adshuria, and Guria. It grows mainly in the subalpine zone of the forests, between 4000 and 7000 ft., often forming with hazel and birch the timber line. Alboff[1] describes it as a shrub 10 to 13 ft. in height, with very variable foliage as regards size and shape,—large broad leaves, 5 to 13 in. long and 2½ to 5 in. wide being characteristic of warm humid districts near the sea; while smaller narrow leaves are the prevalent form in the mountains near the central chain of the Caucasus.

It was seen by Dieck in 1890, who was unable to procure acorns, but brought back cuttings. It was first introduced into England by Lord Kesteven, who collected acorns in September 1905 in the mountains inland from Sukhum-Kaleh, a port on the Black Sea about 100 miles north of Batum. He raised three seedlings, which retained their foliage in March 1910, when they were about 12 to 18 in. high and very thriving. Schneider states that he has only found it in cultivation in the forest garden at Münden in Hanover; but Elwes has recently obtained living plants from the nursery of O. Poscharsky at Laubegast, near Dresden. (A. H.)

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[1] In *Bull. Herb. Boissier*, i. 259 (1893). Cf. also Radde, *Pflanzenverb. Kaukasus*, 182, 188 (1899).

## QUERCUS MACRANTHERA

*Quercus macranthera*, Fischer et Meyer, in *Bull. Soc. Nat. Mosc.* x. 260 (1838); De Candolle, *Prod.* xvi. 2, p. 13 (1864); Boissier, *Flora Orientalis*, iv. 1165 (1879); Schneider, *Laubholzkunde*, i. 192 (1904).

A tree, about 60 ft. in height. Young branchlets stout, covered with dense brown pubescence, retained in the second year. Buds pubescent, with persistent pubescent filiform stipules. Leaves (Plate 337, Fig. 42) deciduous in autumn, 4 to 5 in. long, 2 to 3 in. broad, obovate, acute at the apex, unequal and rounded or cuneate at the base, margin ciliate; with seven to eleven pairs of lateral nerves, each ending in a rounded, short, usually entire, rarely toothed lobe; upper surface dark green, with minute scattered brown hairs; lower surface pale, covered with dense tomentum; petiole ¼ to ½ in., densely pubescent.

Fruits ripening in the first year, sessile or sub-sessile, crowded at the apex of the branchlet; acorns cylindrical-ovoid, nearly an inch long, glabrous, surrounded at the base by a hemispherical cupule, about ½ in. in diameter, covered with loosely appressed pubescent scales, ovate in the basal ranks, and lanceolate towards the margin of the cupule.

This species, which is closely allied to *Q. Toza* and *Q. conferta*, is a native of the mountains of northern Persia and of the Caucasus, between 4000 and 7500 ft. altitude, where it often grows in subalpine meadows near the timber line. It has also been collected in Karabagh and in Armenia. According to Radde,[1] who gives a photograph of a large tree growing amidst tall grass, it attains a great age and considerable size, one tree being recorded as 425 years old, 2½ ft. in diameter, and with 180 cubic ft. in the stem, exclusive of branches.

*Q. macranthera*, which is a very ornamental species, was introduced some time before 1873, as Koch[2] in that year mentions small trees in north-eastern Germany, which were perfectly hardy. Mayr[3] says that it grows fast at Grafrath, near Munich. A tree in Kew Gardens, obtained from Späth in 1895, is about 20 ft. high, and has borne acorns during the last three years. There are also specimens at Westonbirt and Aldenham. (A. H.)

## QUERCUS LUSITANICA, Portuguese Oak

*Quercus lusitanica*, Lamarck, *Encyc.* i. 719 (1783); Webb, *It. Hisp.* 11 (1838); Boissier, *Voy. Bot. Espagne*, ii. 575 (1839-45); Hooker, *Ic. Plant.* vi. t. 562 (1843); Coutinho, in *Bull. Soc. Brot.* vi. 66 (1888).

*Quercus australis*, Link, ex Loudon, *Arb. et Frut. Brit.* iii. 1925 (1838).

A tree, attaining 60 ft. in height and 10 ft. in girth. Bark thick, divided into small quadrangular scaly plates. Young branchlets tomentose. Buds ovoid, acute,

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[1] *Pflanzenverb. Kaukas.* 204, 226 (1899).

[2] *Dendrologie*, ii. 2, p. 44 (1873).

[3] *Fremdländ. Wald- u. Parkbäume*, 502 (1906).

⅙ to ¼ in. long, with ciliate scales. Leaves falling late in the season, coriaceous, variable in shape often on the same branch, averaging 3 in. long, 1¼ in. broad, obovate-oblong, usually rounded at the apex, unequal and cuneate or rounded at the base; lateral nerves seven to nine pairs; margin wrinkled, revolute, with irregular, mucronate, inflexed teeth; upper surface dark green, shining, glabrescent, except on the midrib, which remains pubescent; lower surface covered with a dense greyish tomentum; petiole tomentose, ⅜ in. long.

Fruit ripening in the first year, two or three together on a tomentose peduncle; acorn ellipsoid, ¾ in. long, glabrous, enclosed to a variable height in a hemispherical or urceolate cup, narrowed at the orifice, and covered with appressed tomentose scales.

No species of oak is so variable as *Q. lusitanica*; and after examination of the abundant Spanish and Portuguese material in herbaria, and of the specimens collected by Elwes at Cintra in Portugal, and a fine series of variations obtained by him from Padre Tavares, I am unable to group the numerous forms into distinct varieties. Coutinho, in his valuable paper on the oaks of Portugal, states that the different forms of leaves graduate into each other, and are sometimes found on the same tree, and even on the same branch. The variations are mainly in the size, shape, and texture of the leaves, which have regular or irregular teeth, with or without a mucro at their apex. The dense grey tomentum on the under surface of the leaf and on the branchlets are constant characters, and serve to distinguish this species from the closely allied *Q. lanuginosa*, which has always deep and rounded lobes, not present in *Q. lusitanica.* The variation in some instances is due to the influence of soil, climate, and altitude; but in other cases is perhaps dependent on hybridisation with the other species of oak in the same region.

The principal forms are as follows:—

1. Var. *Broteri*, Coutinho. This is perhaps the typical form, and is described above, from specimens gathered from large trees near Cintra by Elwes. This usually is a large tree, making summer shoots, and characterised by large leaves, with rather irregular teeth.

2. Var. *faginea*, Boissier, *Voy. Bot. Espagne*, ii. 575 (1839-45).

*Quercus faginea*, Lamarck, *Encyc.* i. 725 (1783).
*Quercus valentina*, Cavanilles, *Ic. Fl. Hisp.* ii. 25, t. 129 (1793).

Usually a shrub. Leaves thin in texture, obovate or oblong, 1½ to 2 in. long, ¾ to 1¼ in. wide, regularly toothed, with sharp mucros.

A common form, often a tree, is intermediate between var. *faginea* and var. *Broteri*, the leaves (Plate 335, Fig. 25) being small like the former, coriaceous like the latter; and the teeth, though regular, are without mucros.

3. Var. *alpestris*, Coutinho.

*Quercus alpestris*, Boissier, *Elenchus*, 83 (1838), and *Voy. Bot. Espagne*, ii. 576, pl. 164 (1839-45).

Leaves coriaceous, oblong, 2 to 3 in. long, nearly entire, the mucronate teeth being few, irregular, and inconspicuous. This occurs at high altitudes, and is oftener a shrub than a tree.

4. Var. *humilis.*

*Quercus humilis*, Lamarck, *Encyc.* i. 719 (1783) (not Miller); Webb, *It. Hisp.* 11 (1838); Masters, in *Gard. Chron.*, 1874, p. 112, f. 31.
*Quercus fruticosa*, Brotero, *Fl. Lusit.* ii. 31 (1804).

A low shrub, found in poor sandy soil. Leaves late in falling, 1 to 1½ in. long, obovate-elliptic, irregularly and acutely mucronate-toothed; petiole very short, about ⅛ in. long. According to Webb, this covers arid tracts in central and southern Portugal, and finds its most easterly station near Gibraltar.

5. At Tortworth there is a grafted tree, about 40 ft. high, which was procured from the Elvaston Nursery about forty-five years ago, under the name *Q. serratifolia.*[1] This has narrow leaves, with triangular mucronate teeth, a cuneate base and a long petiole, and is one of the forms assignable to var. *Broteri.* It bears fruit freely, from which seedlings have been frequently raised, said to resemble the parent in foliage. One of these seedlings, planted at Kew, has large obovate-oblong leaves, green and glabrous beneath, auricled at the base, and with a short petiole; and is intermediate between *Q. lusitanica* and *Q. pedunculata.* Its parent was probably pollinated by an adjoining common oak. (A. H.)

## DISTRIBUTION

*Q. lusitanica* is a native of Spain and Portugal, being replaced in the Levant by the closely-allied species, *Q. infectoria.* The range of this species in Spain is very wide. According to Laguna and Avila it is found in all the provinces except Galicia, Asturias, and Biscay, but is commonest in Estremadura and Andalusia.

Captain Widdrington seems to have been the first to call special attention to it,[2] and says that it was a leading feature in the ancient forests of Spain. He found it from the southern part of Andalusia to the centre of Leon, almost to the watershed of Asturias, and from the western Sierra Morena to near Guadalaxara. He notices its extreme variability, and calls it a very beautiful deciduous tree, with shining green leaves varying from 1 to 4 in. in length, and proposed for it the name of *Q. Quexigo.* Laguna and Avila spell this—the common Spanish name—Quejigo.

In Spain it is usually so much cut for firewood that it is rarely seen as a large tree, but in Portugal it attains a great size; and in a paper by Gebhart, in the *Revue des Eaux et Forêts*, I find one recorded in the forest of Cazal do Prado, which was 5·40 metres in girth, and with a crown 26 metres in diameter, which produced 840 litres of acorns in one year.

I saw this oak growing abundantly in central Portugal, especially in the Serra of Cintra. It is a medium-sized or large tree, usually attaining 50 to 60 ft. in height, and 8 to 10 ft. in girth; and in this mild and comparatively damp climate seems to be subevergreen, a few leaves remaining on most of the trees in the beginning of April. Its habit is spreading and branchy, very similar to that of the cork oak. The bark is more like that of *Q. Ilex* than that of *Q. pedunculata*, and never becomes corky.

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[1] According to Koch, *Dendrologie*, ii. 2, p. 78 (1873), an oak with this name was introduced from Spain by Booth of Flottbeck, near Hamburg.

[2] *Spain and the Spaniards*, i. 385 (1844).

Coutinho describes and figures the leaves of supposed hybrids between this species and *Q. pedunculata* and *Q. Toza*, found near Coimbra and in other localities in Portugal.

### CULTIVATION

This tree, which is very rare in cultivation, was introduced in 1835, when plants were raised in the Horticultural Society's garden at Chiswick, from acorns gathered in the neighbourhood of Gibraltar. These seedlings were named *Q. australis*, Link, and in their juvenile stage, according to Loudon's figure, closely resembled specimens gathered at Cintra in their foliage. A tree on the lawn near the gate of the Director's Office, Kew, grafted at about 3 ft., which measures about 35 ft. in height and 5 ft. 9 in. in girth, and ripened acorns in 1909, bears smaller leaves, somewhat intermediate between var. *Broteri* and var. *faginea*. At Lyndon Hall, Rutland, a low tree, about 6 ft. in girth, which recently died, bore similar foliage. Another tree at Kew, in the oak collection, near the bank of the Thames, about 30 ft. in height, and wide-branching from near the base, has much larger leaves, almost glabrescent in autumn, and is probably one of the forms of var. *Broteri*. (H. J. E.)

## QUERCUS INFECTORIA

*Quercus infectoria*, Olivier, *Voy. Emp. Othm.* i. 252, tt. 14, 15 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1928 (1838); J. D. Hooker, in *Trans. Linn. Soc.* xxiii. 383 (1861).
*Quercus lusitanica*, sub-species *orientalis*, De Candolle, *Prod.* xvi. 2, p. 18 (1864).
*Quercus lusitanica*, Boissier, *Fl. Orient.* iv. 1166 (1879) (not Lamarck).

This species, which is the representative of *Q. lusitanica* in the Levant, includes a great number of forms, presenting the same range of variation in the foliage as the Peninsular species; and differs[1] mainly from it in being less pubescent on the branchlets and leaves. The typical form is a shrub or small tree, with very scaly bark. Young branchlets tomentose or glabrescent. Leaves coriaceous, deciduous late in the season, ovate, oblong, or obovate-oblong, about 2 in. long and 1 in. broad; rounded or occasionally acute at the apex; unequal at the base; margin wrinkled, with about six pairs of sinuate teeth, with or without mucros; upper surface light green, shining, glabrous; lower surface pale green, with scattered stellate hairs, glabrescent towards the end of the season; petiole ½ in. long, glabrescent. Fruit similar to that of *Q. lusitanica*.

1. Var. *Boissieri*, De Candolle, *loc. cit.*

*Quercus Boissieri*, Reuter, in Boissier, *Diag. Ser.* i. 12, p. 119 (1842).

Leaves oblong, or obovate-oblong, larger than in the type, up to 3 or 4 in. long, with more numerous acute mucronate teeth.

2. Var. *petiolaris*, De Candolle, *loc. cit.* Leaves oblong, almost entire, or with

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[1] Some specimens from Asia Minor have leaves tomentose beneath, and are indistinguishable from *Q. lusitanica*.

a few inconspicuous irregular teeth. This includes some remarkable forms, which are possibly distinct species.[1]

*Q. infectoria* is widely spread throughout Syria, Asia Minor, Armenia, and Kurdistan; and occurs also in Turkey near Constantinople, and in Cyprus; but appears to be unknown in Greece.[2]

Sir Joseph Hooker saw it in great abundance on the east slopes of Lebanon, on the rocky hills of Galilee south of Safed, and on the summit of Carmel. It occurred as a small tree 15 to 20 ft. high, or more often, as a bush sparingly branched, with a rather slender rugged trunk, and grey deciduous foliage, white on the under surface, and was rendered very conspicuous by the abundance of spherical galls of a deep red brown colour and shining viscid surface.[3] He also speaks of another gall, of smaller size, paler colour, and softer texture with several angular protuberances, found sparingly in Syria and, as he believed, also on this species. Neither of these galls is collected in Syria. The larger and commoner is probably not different from the Aleppo gall, though it may be inferior in quality. Hooker adds that the acorns are of a singularly elegant form and of a bright amber colour.

The galls of this species, known as Aleppo galls, of which a full account is given by Flückiger and Hanbury,[4] are exported from Smyrna and Trebizond; and are used in medicine, for dyeing and tanning, for making tannic and gallic acids, and in the preparation of ink.

We are indebted to Consul H. Shipley of Erzeroum for some drawings of oak leaves and specimens of galls from Kurdistan, which in the absence of acorns cannot be certainly identified, but which, in Dr. Stapf's opinion, belong in part to *Q. pedunculata*. The galls, however, are extremely similar to those commonly found on *Q. lusitanica* in Portugal.

Loudon says that although, according to the catalogues, this tree was introduced into England in 1822, he had never seen a specimen. Apparently[5] it was first cultivated in the Chiswick Garden in 1850, when seedlings were raised from acorns sent by Sir A. H. Layard from Kurdistan, where he had found the tree abundant, especially near Bitlis, which was the emporium for galls. Sir J. Hooker[6] also brought home from Syria, in 1860, acorns in damp earth, from which plants were raised at Kew.

The only specimens that we have seen are at Kew, where a tree of the typical form, about 23 ft. by 2 ft. 3 in. in 1909, is probably one of Hooker's seedlings. Trees of similar size, belonging to var. *Boissieri*, were obtained in 1870 and 1873 from Booth of Hamburg. (A. H.)

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[1] Cf. Schneider, *Laubholzkunde*, i. 191, fig. 120 (1904), who describes and figures, as *Q. veneris*, Kerner, an oak in the Botanic Garden at Vienna, which was raised from an acorn sent by Kotschy from Cyprus. This is identical with *Q. Pfaeffingeri*, var. *cypria*, Kotschy, in Unger and Kotschy, *Die Insel Cypern*, 492 (1865), who state that it once formed extensive woods of fine trees, of which only a few scattered individuals now remain.

[2] It is not mentioned as one of the oaks of Greece, by Halacsy, *Comp. Fl. Græcæ*, iii. 125 (1904).

[3] Figured by Lambert, in *Trans. Linn. Soc.* xvii. t. 22 (1837).

[4] *Pharmacographia*, 595 (1879).

[5] *Journ. Hort. Soc. Lond.* viii. 132 (1853).

[6] *Trans. Linn. Soc.* xxiii. 383 (1861).

## QUERCUS GLANDULIFERA

*Quercus glandulifera*, Blume, in *Mus. Bot. Lugd. Bat.* i. 295 (1850); Skan, in *Journ. Linn. Soc.* (*Bot.*), xxvi. 514 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 50, t. 26, figs. 13-24 (1900).

A small tree, rarely attaining 50 ft. in height. Young branchlets slender, covered with quickly deciduous appressed pubescence. Buds ovoid, ⅛ in. long, with ciliate glabrous scales. Leaves (Plate 335, Fig. 27) deciduous in autumn, 3 to 5 in. long, 1 to 2 in. broad, membranous, obovate or elliptical, acuminate at the apex, usually cuneate at the base; with eight to eleven pairs of lateral nerves, all but the lowest pair ending in a serration, tipped with a short glandular cartilaginous mucro; upper surface dark green, shining, with deciduous appressed silky pubescence; lower surface pale green, with similar but persistent pubescence; petiole ¼ to ½ in long, appressed, pubescent.

Fruit, ripening in the first year, solitary or clustered, on a glabrescent short peduncle; acorn ½ in. long, surrounded at the base by a shallow cupule, ½ in. broad, covered with lanceolate pubescent scales.

This species is widely spread throughout China, Korea, and Japan. There are four small trees at Kew, about 10 ft. high, which were obtained from the Arnold Arboretum in 1893; and a small specimen is also growing at Aldenham.

(A. H.)

## QUERCUS GROSSESERRATA

*Quercus grosseserrata*, Blume, in *Mus. Lugd. Bot.* i. 306 (1850); Sargent, *Forest Flora of Japan*, 67 (1894); Shirasawa, *Icon. Ess. Forest. Japon*, text 53, t. 27, figs. 16-28 (1900).
*Quercus crispula*,[1] Blume, var. *grosseserrata*, Miquel, in *Ann. Mus. Bot. Lugd.* i. 104 (1863).

A tree, attaining 100 ft. in height and 12 ft. in girth. Branchlets and buds glabrous. Leaves (Plate 337, Fig. 49) deciduous in autumn, sub-sessile, membranous, 4 to 6 in. long, 3 to 3½ in. broad, obovate, acuminate at the apex, tapering to a narrow auricled truncate base, with twelve to fifteen pairs of regular triangular non-mucronate teeth; upper surface dull, dark green, glabrous except for long hairs on the midrib; lower surface paler, glabrous, with long hairs on the midrib and lateral nerves, each of which except the lower one or two pairs ends in the apex of a tooth; petiole ⅛ in., glabrous.

Fruit ripening in the first year, clustered at the ends of the branchlets, solitary or two to three on short peduncles; cupule hemispheric, about ½ in. in diameter, with appressed grey tomentose ovate scales, enclosing about one-third of the ovoid acorn, which falls out of the cupule when ripe. (A. H.)

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[1] *Quercus crispula*, Blume, in *Mus. Lugd. Bot.* i. 298 (1850), according to Sargent, is indistinguishable in foliage; but is said by Miyabe to have different fruit, the cupule being deeper and enclosing half the cylindrical acorn, cupule and acorn falling together when ripe. Shirasawa only mentions and describes one species, *Q. grosseserrata*.

*Q. grosseserrata*[1] is a native of Japan and the Kurile Isles, and is said to have a more northerly distribution than *Q. crispula*, though both, according to Sargent, grow together on the hills of central Yezo, forming large trees and producing timber of excellent quality. I collected this oak at Asahigawa, in this region, at 500 ft. elevation, where it was growing in open forests mixed with *Q. dentata*. Sargent reports *Q. crispula* to be common on the low ground and near the banks of streams in Yezo; and states that he saw fine forests of it on the Nikko mountains. It is known as *onara* in Japan, where the timber is largely used for sleepers. I believe that this tree produces the greater part of the oak timber which has lately been exported in quantity to Europe and to California, and is very favourably spoken of by Messrs. Marsh, Jones, and Cribb of Leeds, who have used it for furniture. When quarter sawn it shows a good figure, and is not easy to distinguish from Austrian oak.

Sargent collected acorns of this oak in Japan in 1892, from which plants were raised in the Arnold Arboretum. These are said by Rehder to be perfectly hardy and to bear handsome foliage. Some of these plants, sent to Kew in 1893, are about 10 ft. high, but do not look very thriving. Acorns sent to me by Prof. Miyabé from Sapporo in 1905 germinated, but grew badly on my soil, and are now dead.

(H. J. E.)

## QUERCUS GLAUCA

*Quercus glauca*, Thunberg, *Fl. Jap.* 175 (1784); Franchet et Savatier, *Enum. Pl. Jap.* i. 448 (1875), and ii. 501 (1879); Hooker, *Fl. Brit. India*, v. 604 (1888); Skan, in *Journ. Linn. Soc.* (*Bot.*) xxvi. 515 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 56, t. 30, figs. 13-24 (1900); Gamble, *Indian Timbers*, 677 (1902).

*Quercus annulata*, Smith, in Rees, *Cyclop.* xxix. No. 22 (1819); Loudon, *Arb. et Frut. Brit.* iii. 1921 (1838).

*Quercus phullata*, Buchanan-Hamilton, in D. Don, *Prod. Nep.* 57 (1825).

A large tree. Young branchlets pubescent at first, soon becoming glabrous. Leaves (Plate 338, Fig. 52) coriaceous, persistent two or three years, about 3 in. long and 1 in. broad, lanceolate, acuminate at the apex, rounded or cuneate at the base, margin mucronate-serrate in its upper half; lateral nerves about ten pairs, prominent beneath; upper surface green, glabrous; lower surface greyish or white, with scattered appressed silky hairs; petiole ½ in. long, glabrous or with scattered hairs.

Fruit (section *Cyclobalanopsis*) ripening in the first year, one to three, sessile on a short stalk; acorn ovoid, acute, much exserted, similar to that of *Q. Vibrayeana*; cupule hemispheric, about ½ in. wide, with grey tomentose scales, connate into four to eight concentric zones, the lower with crenate, the upper with entire margins.

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[1] *Q. grosseserrata* is closely allied to *Q. mongolica*, Fischer, *ex* Turczaninow, in *Bull. Soc. Nat. Mosc.*, 1838, p. 101. The latter species is widely spread in Dahuria, Amurland, Manchuria, Mongolia, and northern China. The leaf, bud, and branchlet of *Q. mongolica* are figured in Plate 337, Fig. 48; and a small tree in Kew Gardens, sent by Sargent in 1893, under the name of *Q. crispula*, is possibly this species. As a rule, the plants usually found in cultivation under the name *Q. mongolica* are *Q. lanuginosa*.—(A. H).

The above description applies to the Japanese form. The species is very variable in the wild state in foliage, and several varieties have been described. In Himalayan specimens the serrations of the leaves have long mucronate points.

The following peculiar variety probably originated in Japanese gardens:—

Var. *lacera*, Matsumura, *Shokubutsu Mei-I*, 243 (1895).

*Quercus lacera*, Blume, in *Mus. Lugd. Bat.* i. 306 (1850).

Leaves obovate, ovate, or lanceolate, with the apex prolonged into a long slender caudate acumen; margin deeply lobed, each lobe ending in a long cartilaginous point.

There is a small plant of this variety in Kew Gardens, introduced in 1907 from Yokohama.

*Quercus glauca* is widely spread in eastern Asia, occurring in the Himalayas from Kashmir to Bhutan at 3000 to 6000 ft., throughout the mountains of China, and in Japan and Formosa. Sargent[1] states that the acorns are eaten by the Japanese, and are of considerable commercial importance.

The Himalayan form was introduced in Loudon's time, as there were plants about 10 ft. high at Kew, Chiswick, and Loddiges' nursery; but none of these appear to have survived. The only specimen which we have seen is a small tree at Tortworth, probably of Japanese origin, which appears to be perfectly hardy, but has never borne fruit. (A. H.)

## QUERCUS VIBRAYEANA

*Quercus Vibrayeana*, Franchet et Savatier, *Enum. Pl. Jap.* i. 449 (1875), and ii. 498 (1879); Skan, in *Journ. Linn. Soc.* (*Bot.*) xxvi. 522 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 55, t. 29, figs. 16-31 (1900).

*Quercus bambusifolia*, Fortune, in *Gard. Chron.*, 1860, p. 170; Masters,[2] in *Gard. Chron.* i. 632 (1874). (Not Hance.)

*Quercus acuta*, Thunberg, var. *bambusæfolia*, Masters, in *Kew Handlist, Trees*, 181 (1896).

A tree, attaining about 50 ft. in height. Young branchlets slender, glabrous. Buds ovoid, minute, glabrous. Leaves (Plate 338, Fig. 55) coriaceous, persistent two years, 3 to 4 in. long, 1 to 1¼ in. broad, often larger on young plants, lanceolate, cuneate at the base, long acuminate at the apex, which is often tipped with a mucro; lateral nerves, nine to twelve pairs, slender, inconspicuous; margin minutely serrate in the upper half of the blade; upper surface dark green, shining, glabrous; lower surface pale green, glaucescent, glabrous; petiole ¼ to ½ in. long, glabrous.

Fruit (section *Cyclobalanopsis*) ripening in the first year, two to four, sub-sessile on a slender peduncle, about 2 in. long, the upper part of which has fallen, bearing with it the unripened pistillate flowers; acorn ovoid, pubescent towards the tip, which is marked with a lamellate umbo, crowned by the persistent style; cupule hemispheric, about ⅔ in. in diameter, with grey tomentose scales, connate into seven or eight concentric zones.

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[1] *Silva N. Amer.* viii. 11, note 48 (1895).

[2] The plant here described by Masters is incorrectly excluded from *Q. Vibrayeana* in *Journ. Linn. Soc.* (*Bot.*) xxvi. 522 (1899).

This is a rare tree, occurring in Japan, where it was found near Nikko by Savatier, and in the mountains of Chekiang, in China, whence it was introduced[1] into cultivation, under the name *Q. bambusifolia*, by Fortune in 1854. Fortune[2] saw trees 30 to 50 ft. in height; but, as far as we have seen, it has remained shrubby in this country. There are specimens at Kew, Eastnor, and Syon. (A. H.)

## QUERCUS ACUTA

*Quercus acuta*, Thunberg, *Fl. Jap.* 175 (1784); Shirasawa, *Icon. Ess. Forest. Japon*, text 60, t. 32, figs. 1-13 (1900).
*Quercus Buergerii*, Blume, in *Mus. Lugd. Bat.* i. 299 (1850).
*Quercus marginata*, Blume, in *Mus. Lugd. Bat.* i. 304 (1850).

A small tree; young branchlets covered with a dense brownish tomentum, speedily deciduous, though traces of it persist near the tip of the branchlet and above the insertions of the leaves. Buds spindle-shaped, ⅓ in. long, with reddish glabrous scales. Leaves (Plate 338, Fig. 56) coriaceous, persistent for two years, 4 to 5 in. long, 1½ to 2 in. wide, elliptical; gradually tapering at the base, and prolonged as a narrow wing on each side of the petiole; abruptly contracted into an acuminate apex; entire in margin or with undulate slight crenations towards the apex; lateral nerves about nine pairs, dividing and looping before reaching the margin; glabrous on both surfaces, dull or yellowish green below; petiole ½ to 1 in., glabrous.

Fruit (section *Cyclobalanopsis*) ripening in the second year, clustered on a tomentose peduncle; acorn ovoid, with a laminate pubescent umbo; cupule hemispheric, with tomentose scales connate into about six concentric zones.

This species, which is a native of Japan, was introduced into England by Maries in 1877. It forms a large bush in this country, where it is perfectly hardy, the finest specimen probably being one at Coombe Wood,[3] growing on a cold clay soil in an exposed position, and about 20 ft. in height. Seedling plants vary much in habit.

A specimen at Kew, from Holker Hall, bears immature fruit. (A. H.)

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[1] Cf. F. B. Forbes, in *Journ. Bot.* xxii. 85 (1884).

[2] *Gard. Chron.*, 1860, p. 160. In the Cambridge Herbarium there is a specimen dated 1860, from a plant in Glendinning's nursery, raised from acorns sent by Fortune, and labelled *Q. bambusifolia.* The leaves of this specimen, like most of the plants in cultivation, have smaller serrations than those which occur on native adult trees.

[3] *Hortus Veitchii*, 405 (1906). Cf. also *Woods and Forests*, 1884, p. 85, and *The Garden*, xix. 285, fig. (1881).

## QUERCUS DENSIFLORA

*Quercus densiflora*, Hooker and Arnott, *Bot. Voy. Beechey*, 391 (1849); Hooker, *Icon. Plant*, t. 380 (1841); Sargent, *Silva N. Amer.* viii. 183, t. 438 (1895).
*Quercus echinacea*, Torrey, *Pacific R. R. Rep.* iv. 1, p. 137, t. 14 (1856).
*Pasania densiflora*, Oersted, in *Kjoeb. Vidensk. Medd.*, 1866, p. 83; Schneider, *Laubholzkunde*, i. 161 (1904); Sargent, *Trees N. Amer.* 225 (1905).

A tree, attaining in California 80 or 90 ft. in height, and 18 ft. in girth. Bark divided by narrow fissures into broad rounded scaly ridges. Young branchlets with a dense stellate tomentum, partly retained in the second year. Leaves (Plate 338, Fig. 54) coriaceous, persistent two or three years, 3 to 4 in. long, 1 to 2 in. broad, oblong or ovate-oblong, acute or rounded at the apex, rounded at the base; with about twelve pairs of prominent lateral nerves, all but the lower one or two pairs ending in a cartilaginous-tipped serration; margin revolute; upper surface shining green, glabrous; lower surface rusty pubescent at first, ultimately becoming glabrous and whitish or greyish, some pubescence being often retained on the midrib near the base; petiole ½ to ¾ in. long, tomentose.

Fruit (section *Pasania*) ripening in the second year, solitary or in pairs on a stout tomentose peduncle; acorn about 1 in. long, enclosed at the base in a shallow cupule, ¾ in. in diameter, with scattered long hairs within; and covered externally with spreading or recurved, long linear rigid stellate-pubescent scales, usually tipped with a reddish gland.

Var. *echinoides*, Sargent,[1] is a shrubby form, with small entire leaves, growing at high elevations in the Siskiyou mountains and the northern part of the Sierra Nevada.

*Q. densiflora* is distributed from the valley of the Umpqua river in Oregon, southwards through the coast ranges to the Santa Inez mountains in California, and along the western slope of the Sierra Nevada, below 4000 ft. elevation, to Mariposa County. It is abundant in the coast region north of San Francisco bay, and attains its largest size in Napa and Mendocino Counties. Sargent[2] gives a good illustration of a fine tree near San Francisco. This species has been much cut down on account of its bark, which contains a large amount of tannin; but owing to the vigorous way in which the stumps produce coppice shoots, there is little danger of its extinction.

This tree is apparently unknown in cultivation in Europe, except at Kew, where there are two healthy trees, which scarcely suffered[3] from the severe winters of 1879-80, and 1880-81. One in the oak collection measures 21 ft. high by 14½ in., the other, near the flagstaff, is 18 ft. by 1 ft. These were raised from acorns sent to Kew by Prof. Sargent in November 1874. (A. H.)

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[1] *Silva N. Amer.* viii. 183, note.

[2] *Garden and Forest*, v. 517, fig. 89 (1892).

[3] Cf. *Gard. Chron.* xvii. 228 (1882).

## QUERCUS GLABRA

*Quercus glabra*, Thunberg, *Fl. Jap.* 175 (1784); Franchet et Savatier, *Enum. Fl. Jap.* i. 447 (1875); Masters, in *Gard. Chron.* xiv. 784, fig. 153 (1880).

*Pasania glabra*, Oersted, in *Kjoeb. Vidensk. Medd.*, 1866, p. 81; Shirasawa, *Icon. Ess. Forest. Japon*, text 61, t. 32, figs. 14-24 (1900); Schneider, *Laubholzkunde*, i. 160, fig. 95 (1904).

A small tree with smooth bark. Young branches glabrous. Leaves (Plate 338, Fig. 50) coriaceous, persistent for two or three years, 4 to 5 in. long, 1 to 1½ in. broad, lanceolate or elliptical, tapering at the base and prolonged as a narrow wing on each side of the petiole; apex acute or contracted into a short acumen, rounded at the tip; margin entire, revolute; upper surface shining, glabrescent; lower surface pale, glabrous, with numerous shining minute dots; lateral nerves about ten pairs, dividing and looping before reaching the margin; petiole glabrous, ¼ to ¾ in. long.

Fruit (section *Pasania*) ripening in the second year, grouped in threes and numerous, but only a few developing, on an erect spike about 4 in. long; acorn ovoid, about an inch long, pointed, glabrous, surrounded at the base by a shallow cupule, ½ in. in diameter, covered with appressed grey tomentose ovate acuminate scales.

*Q. glabra* is a native of Japan, and was introduced[1] into cultivation in England in 1842, when plants were raised in the Tooting and Epsom Nurseries. We have not been able to separate as distinct var. *latifolia*[2] introduced by Maries in 1877. This species does not appear to be quite so hardy as *Q. acuta*, and remains a large bush, often seen in gardens in the south and west of England, and in Ireland, where it ripens fruit.[3] There are specimens in the oak collection at Kew. (A. H.)

## QUERCUS CUSPIDATA

*Quercus cuspidata*, Thunberg, *Fl. Jap.* 176 (1784); Franchet et Savatier, *Enum. Pl. Jap.* i. 449 (1875); Masters, in *Gard. Chron.* xii. 232, f. 38 (1879); Skan, in *Journ. Linn. Soc.* (*Bot.*) xxvi. 510 (1899).

*Pasania cuspidata*, Oersted, in *Kjoeb. Vidensk. Medd.*, 1866, p. 81; Shirasawa, *Icon. Ess. Forest. Japon*, text 62, t. 34, figs. 1-13 (1900); Schneider, *Laubholzkunde*, i. 160 (1904).

A large tree. Bark smooth on young stems, deeply fissured on old trunks. Young branchlets glabrescent. Leaves (Plate 338, Fig. 51) coriaceous, persistent two or three years, 2 to 3 in. long, ¾ to 1 in. broad, elliptical; base tapering and prolonged as a narrow wing on each side of the petiole; apex long acuminate, rounded at the tip; margin entire, revolute; lateral nerves about eight pairs, inconspicuous, dividing and looping before reaching the margin; upper surface shining, dark green, glabrous; lower surface pale, with deciduous minute appressed pubescence, and showing under the lens shining dots; petiole ¼ in., with scattered minute pubescence.

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[1] Loudon, *Gard. Mag.* xviii. 17, 41 (1842). Gay, in *Bull. Soc. Bot. France*, v. 32 (1858), mentions a small plant at Verrières in 1858; but this is not referred to in *Hortus Vilmorinianus*, published in 1906.

[2] Veitch, *Cat. Trees and Shrubs*, 1881-82, p. 22, and *Hortus Veitchii*, 405 (1906).

[3] It ripened fruit in 1852 at Bishopstoke, Hants, according to *Gardeners' Chronicle*, 1852, p. 695.

Fruit (section *Pasania*) ripening in the second year, six to ten alternate and sessile on an erect peduncle; cupule ovoid, acute, ¾ in. long, composed of several rows of coalesced tomentose scales, completely enclosing the acorn, which is set free by the irregular splitting of the cupule into two to four valves.

This species is a native of Japan, Formosa, Korea, and central and southern China. According to Sargent,[1] it is the most widely distributed evergreen oak of Japan, often forming extensive forests in southern Hondo. Its acorns are edible when cooked and are sold in the Japanese markets. The most valuable mushroom of Japan is artificially cultivated upon pieces of the bark of this tree.[2]

Siebold[3] sent acorns of this and other Japanese oaks to Leyden in 1830; but it appears to have been first introduced into England in 1879 by Maries.[3] The only specimens which we have seen, those at Coombe Wood and at Kew, are shrubby in habit. Maries also sent home from Japan a variegated form (var. *variegata*),[4] which does not seem to be now in cultivation. (A. H.)

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[1] *Silva N. Amer.* viii. 11, note 51 (1895).

[2] Robertson, *Commercial Reports by H.M. Consuls in Japan*, 1875, p. 52.

[3] Siebold et Zuccarini, *Fl. Jap.* i. 11 (1835).

[4] Cf. *Gard. Chron.* xii. 232, fig. 38 (1879), where a figure is given of var. *variegata*.

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